INDUSTRIAL LOCATION
AND
NATIONAL RESOURCES

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DECEMBER 1942

NATIONAL RESOURCES PLANNING BOARD

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WASHINGTON, D. C.

THE PRESIDENT,

The White House. *February 17, 1943.*

MY DEAR MR. PRESIDENT:

We have the honor to transmit herewith a report on the location of industry in the United States. The report consists of studies prepared under the general supervision of Ralph J. Watkins, Assistant Director, and Glenn E. McLaughlin, Chief of the Industrial Section. Representing the first comprehensive analysis of the subject to be made in this country, these studies are primarily concerned with a review of the various factors which influence plant location decisions and which therefore are shaping the geographic pattern of American industry.

The American economy is and always has been an expanding economy, and each decade has brought with it significant changes in the geographic pattern of industry. But never before have these changes been so rapid as since the beginning of the defense period. By the end of 1943 the expansion of our manufacturing facilities for war production purposes will total approximately $18 billion, more than $15 billion of this investment representing Federal funds. Through this tremendous investment we have not only vastly increased the Nation's manufacturing plant, but we have brought about important changes in the geographic pattern of manufacturing. The consequences of these changes will have a permanent influence on the growth and development of the Nation. Because of these great changes, both private industry and local, State, and Federal agencies of government have become increasingly aware of the necessity of giving careful thought to plant location decisions. This report has been prepared to meet the growing need for objective analysis of locational problems.

The report consists of an introductory summary and five principal parts. The first part is concerned with the relation between the distribution of the basic resources of the Nation and the locational patterns of industry. Consideration is then given in the second section to the growth of our manufacturing industries and recent shifts in their geographic distribution.

The third part of the report is devoted to an analysis of the chief production and distribution factors which have a bearing on locational decisions. An attempt is made to trace the locational pull of each of these elements on particular classes of industry. Separate consideration is given to the locational pull of raw materials, power and fuels, water supply, transportation facilities and services, labor supply, markets and marketing facilities, capital, and management.

The fourth part of the report analyzes organizational factors which influence the locations of particular industries. The factors reviewed are: size of plant, size of company, and size of city; degree of integration in the plant and in the company; and financial controls and monopolistic influences. Certain special aspects of the location problem are then considered, including an analysis of the place of the small manufacturing firm in the Nation's industrial economy and the special problems and public policy questions which are involved in efforts to encourage and expand this type of activity. Attention is given also to the geographic aspects of the pricing policies of manufacturing establishments and to governmental and community influences in the location of industry.

The final section is devoted to an over-all review of principles and methods of selection of plant locations.

Since the initiation of the defense program in 1940, the staff of the Board has reviewed and advised on all major proposals for expansion of industrial facilities sponsored by Government agencies. That relationship was established initially in response to a request from the Advi-

sory Commission to the Council of National Defense and was continued through the Office of Production Management and later through the War Production Board. By designation of the Chairman of the War Production Board, Mr. McLaughlin has served as a member of the Plant Site Board and later as adviser to the Facility Clearance Board, its successor. In this work for the war agencies the analyses and materials developed in the present report have been in continual use by our staff.

Our objective in reviewing war plant proposals has been to seek out and recommend locations which in so far as possible would conform to the war criteria of speed in output but which also would create a minimum of local maladjustment and contribute toward a balanced use of available industrial resources in the several regions of the country. In many instances, however, it has not been possible to meet all these requirements, since military necessity often required the overruling of economic criteria. The failure was in part unavoidable, since time was the Nation's most limited resource and speed of output the most urgent goal.

After the war both private industry and governmental agencies will be faced with serious problems of minimizing the maladjustments resulting from wartime industrial expansion. A particular responsibility will rest on the Federal Government in the disposal of its huge investment in war plants and in promoting the conversion or adaptation of many of these war plants to peacetime uses. The present report will, we believe, be of material assistance to the agencies of government concerned with these problems and likewise to private business in its task of readjustment and conversion of industrial operations to peacetime uses. It is our belief also that regional and State planning boards and local development commissions will find this report of great assistance in their development work.

The criteria outlined in the report will help to focus the interests and efforts of both private industry and public or quasi-public development agencies on more rational locational decisions and, therefore, should aid in developing a more stable and productive economy.

Respectfully submitted.

Frederic A. Delano,
Chairman.

Charles E. Merriam.

George F. Yantis.

INDUSTRIAL LOCATION AND NATIONAL RESOURCES

CONTENTS

INTRODUCTION

Industrial Location and National Welfare

The mobilization of the American economy for war has necessitated a vast expansion in our facilities for producing military equipment. Armament and munitions plants in existence before the war, even when utilized to the fullest extent, could produce only a fraction of the required output. Consequently, we have had to convert ordinary peacetime plants into producers of war goods, to enlarge both old war plants and converted plants, and to construct an unprecedented capacity in new plants.

Under these developments the Federal Government has necessarily influenced materially the geographic distribution of industry. The selection of sites for Government-owned plants, including those placed under private operation, has been an immediate governmental responsibility; and the choice of locations for privately owned plants, when financed by Federal funds, has also been subject to considerable governmental control. But the wartime influence of Government on the location of industry has by no means stopped here. Important, though less direct, locational effects have resulted from the granting of certificates of necessity, allowing the rapid amortization for tax purposes of investments in approved new productive facilities; from the allocation of war orders, including the encouragement of subcontracting; and from the direct restriction of production for civilian consumption.

Before the war, the influence of the Federal Government on industrial location was almost entirely indirect and unplanned. This influence developed in connection with policies directed primarily towards other objectives, for example, regulation of transportation, development of power resources, or establishment of labor standards. Local governments, to be sure, formulated some direct policies, such as zoning ordinances, but local efforts to attract industry and control location were of limited scope and were made without consideration of their effects on other communities.

In the location of war plants, primary emphasis has been placed on the strategic factors of speed of production and, to a lesser extent, safety from enemy attack. These requirements have not and could not in many instances be met with full regard for economic and social considerations. Even though the plant site groups in the war production agencies have been able to influence the location of many industrial facilities in order to make effective use of available production factors, serious over-concentration of workers has occurred in certain areas and under-employment in others. Consequently, major readjustments between population and industry will be required after the war if a high degree of employment is to be achieved on a peacetime basis.

In order to effect these readjustments, local as well as national governmental agencies may well concern themselves much more directly than they did before the war with problems of industrial location and economic development. The task of aiding private industry in providing economic opportunities for men to be demobilized from the armed forces and from munitions industries will demand careful attention both to the conversion of war production centers to peacetime activities and to the establishment of new industries based on the resources of underdeveloped sections of the country.

The location of industry presents issues of such continuing importance to the Nation as a whole that the National Resources Planning Board has undertaken a comprehensive study of the subject. Analyzed in this volume are the various factors that enter into locational decisions and hence shape the geographic structure of American industry. Attention has been directed primarily to the locational behavior of manufacturing industries rather than to trade and other branches of nonmanufacturing activity. Emphasis has thus been placed on the more active and independent factors of the locational problem.

In so far as this analysis leads to a better understanding of location problems, it may provide needed criteria for private business as well as a base for evaluating the extent and direction of desirable aid from local and national governmental agencies in the post-war period. Wartime locational developments will be analyzed in detail in a succeeding volume which, in addition, will discuss and advance proposals for dealing with locational and other problems of post-war industrial readjustment.[1]

[1] Reports dealing with recent industrial developments in four regions—Middle Atlantic, Mountain States, Pacific Northwest, and Pacific Southwest—have been prepared for the National Resources Planning Board by the planning commissions of the areas concerned. Copies are obtainable from the Superintendent of Documents, Washington, D. C.

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Type of Activity and Locational Choice

Broadly speaking, the gainfully occupied population is distributed among extractive industries, manufacturing, and the various types of services. The effects of industrialization and urbanization have been a great reduction in the proportion of total workers found in the extractive industries; an increase, until recent years, in the proportion absorbed by manufacturing; and a continued rise in the proportion occupied in service pursuits. This development has an important bearing on the definition of locational policy because of the varying degree to which the location of the several branches of economic activity is fixed or subject to direction.

The geographic pattern of the three groups of industries is governed by different factors. Agriculture and the other extractive industries are necessarily tied closely to the resources they exploit, although in some cases the wide distribution of these resources permits other factors to play a large part in the selection among alternatives. Service activities must, for the most part, stay close to the consumer so that their distribution tends to correspond roughly with that of population or, in some instances, more closely with that of consumer income. Some service industries are found mainly in a few large urban centers. The location of manufacturing activity as a whole is not subject to any such simple generalization. Although certain manufacturing industries do owe their location to the dominant influence of a particular requirement, the majority cannot be properly treated without careful consideration of a multitude of production and organizational factors. Some are closely tied to their markets; their regional distribution, therefore, does not differ materially from that of most of the services. Other industries are obliged to locate near an appropriate labor supply or near cheap power. A number, usually because of the great loss of weight in manufacturing, have to establish themselves near the source of materials.

In this volume consideration has been given primarily to the factors underlying the general problem of industrial location, rather than to an analysis of the location of specific industries.

Locational Patterns

The geographic structure of industrial activity has been derived basically from the location of natural resources and from historical and physical factors directing the course of population settlement, including the geographic features which determine transportation routes. As a country becomes industrialized, great differences may appear between the geographic pattern of industry and the distribution of natural resources, because the development of improved transportation, and technological progress generally, make possible the manufacture of complex products required for a high standard of living.

Rich as the United States is in natural resources, those which can be profitably worked are fairly concentrated. Such concentration is greatest in mineral deposits, so that mining is considerably localized. Bituminous coal mining, for example, is centered in Pennsylvania and West Virginia to such a degree that these two States, with less than one-tenth of the Nation's gainfully employed, have one-half of the labor force thus engaged. Again, the bulk of our iron ore supplies is secured from the deposits in the Lake Superior district. Even in agriculture, owing to diversities in soil, climate, topography, markets, historical developments, and other factors, there is much regional concentration of particular kinds of production as well as a considerable variation in total production. We have, for instance, wheat, corn, cotton, and citrus fruit belts. In most of the area east of the Appalachians, the lower productivity of soil and the larger expenditure necessary for upbuilding than in the Mississippi Valley (the Corn Belt, for example) have tended, with the progress of settlement, to restrict agricultural production to those lines which derive maximum advantage from proximity to large consuming markets. Accordingly, the share of this area in total agricultural production has declined. In the Great Plains area and a large part of the western Mountain States, low rainfall restricts agriculture largely to stock raising, except for the limited and scattered areas where irrigation is practicable.

The physical environment has exercised an important influence on the location of manufacturing as well as of agriculture. About one-third of the United States is so mountainous as to be comparatively unfavorable for the development of any considerable volume of manufacturing. Waterways, on the other hand, have attracted industry to such a degree that the great majority of our large industrial cities grew up along the two coasts, the Great Lakes, or the principal rivers. Although climate may favor or discourage the establishment of certain processes and may also affect the productivity of workers, its influence on location is far less in industry than in agriculture.

Manufacturing is concentrated mainly north of the Ohio River and east of the Mississippi River. Although the States in this section contain only one-half of the gainfully employed population, they account for no less than 70 percent of all workers engaged in manu-

facturing. Manufacturing is, however, reaching out into new regions and particular industries are being redistributed. Even over comparatively short periods such movements may attain appeciable volume. For example, in the cyclically comparable years 1929 and 1937, employment remained at uniform levels in only a few industries. Not only did the numbers employed in the great majority of industries expand or contract, but there was also much change within industries in terms of employment opportunities in different regions of the country. In the process of redistribution, the most conspicuous gains occurred in the Southeast at the expense of industries in the Northeast. Within the manufacturing belt, important cross movements took place between the Northeast and Midwestern States, but with a balance in favor of the latter. Labor-cost differentials and market considerations predominated as causes of these shifts. The development of new sources of raw materials accounted for the shifts in about one-quarter of the industries and one-fifth of the wage jobs.

The extent to which manufacturing operations may be carried on at a distance from raw materials is indicated by the fact that, except for coal, these materials are produced in the main outside the manufacturing belt. The location of Appalachian coal reserves combined with the low-cost water transportation of iron ore from Lake Superior have determined the major concentration of the heavy industries. The geographic drawing power of most of the other mineral resources is limited for the most part to primary refining; their influence on manufacturing is restricted by the small quantities used, high unit values, and the necessity of using them in combination with other materials. Petroleum has had only secondary locational effects, owing in part to the revolutionary change in transportation by pipe line or tanker. In recent years, cheap natural gas in the Southwest has become an important attracting force.

Interrelationships of Locational Influences

The selection of a location for a manufacturing plant usually requires the careful weighing of a number of interrelated factors. Production and distribution problems require consideration of the sources of materials, fuel, and power; the need for special labor skills, prevailing wage levels, and the efficiency of labor; availability of management; transportation facilities, service, and costs; and the nature, location, and extent of the market. Certain organizational factors must also be considered, such as the most satisfactory size for the plant, the extent to which operations can be integrated with related processes, and the proximity to other industries. Thus, the industrialization of an area leads to cumulative advantages for industries in related and even in unrelated fields. Sometimes the choice of a location may be influenced by inducements offered by local bodies or governments, by Federal or State laws or regulatory policies, and by price policies, or by the personal preferences of some controlling individual or group.

The location of a plant or the locational pattern of an industry cannot always be attributed to the logical weighing of a great number of factors. In some instances the location of an industry in a given place may be attributable to little more than historical accident.

A shift in the location of a plant is likely to entail the sacrifice of much of the investment in the old site and building, a serious interruption to operations, the loss of valuable employees, and considerable expense for moving equipment and records. Add to these the force of inertia, and the offsetting advantages elsewhere may have to appear great indeed to induce a move. Accordingly, changes in the locational pattern of an industry are effected only to a comparatively small extent by the actual transfer of the equipment and personnel of a plant from one place to another. Such changes come about mainly through the expansion of the industry in new and more favorable locations and its gradual decline in old centers, owing to insolvencies or obsolescence and failure to replace equipment.

In some manufacturing industries there may be little choice among places or regions in the selection of a location. The industries enjoying the least freedom of location are those in which dominant importance attaches to cheap and ready access to raw materials, fuel, power, or markets, to the availability of certain kinds of labor, or to some other particular factor. There are relatively few industries in which one location factor far outweighs any other. More commonly, several factors play an important part in the determination of a location. Under this condition, there is a wide scope for the excise of judgment and discretion. It is, therefore, with respect to these "foot-loose" manufactures that public policy can exercise its greatest influence in directing changes in geographic patterns in accordance with social objectives.

Production and Distribution Factors

Contrary to common belief, the great majority of manufacturing plants do not use basic raw materials directly; they obtain partly manufactured articles and process or assemble them further for various uses. Only about 20 percent of the industries covered by the *Census of Manufactures* are direct processors of basic raw materials. But since most of these use mainly one or two materials, the locational pull toward sources of the predominant materials in this group is on the whole

powerful. The pull is strongest where the primary material is perishable, or where processing results in great reduction in weight or bulk. Thus, weight loss and perishability of raw materials explain the location of fruit and vegetable canneries and sugar-beet refineries in or near growing areas. Similarly, the extremely small metal content of most nonferrous ores constitutes the main reason for smelting them close to the mines. Loss of weight is much less in the smelting of iron ores. Moreover, the iron industry requires large quantities of fuel, which are consumed almost entirely in the process of smelting. Thus the greater part of the iron and steel industry is scattered through a belt stretching from the major sources of iron ore to the sources of coking coal, with points of concentration determined largely by the market factor. Lack of a large market explains why a relatively small part of the industry is located at Lake Superior port areas where, owing in part to the influence of cheap water transportation for coal, the assembly costs are relatively favorable. In recent years, the use of scrap metal has grown in importance, particularly in the steel industry where sufficient supplies of scrap iron and steel have become available to make possible the establishment of small plants which are dependent on scrap for their basic material. These plants, necessarily located chiefly with respect to the sources of scrap, to fuel requirements, and to markets, are in many instances far from both the main steel producing centers and the iron mines.

Industries which depend largely on foreign sources for their raw materials tend to be attracted to seaboard locations, not entirely because of loss of weight in processing, for in many instances there is no considerable loss, but because of a combination of reasons, including prompt delivery, convenience of assembly, and nearness to major markets. Other factors sometimes lead to inland locations for industries of this type; for example, the rubber tire industry.

Most of the industries which work on partly manufactured goods instead of basic raw materials fabricate a product or products combining many different raw materials. Industries of this kind are therefore rarely located with special regard to any particular raw material; if the supply of such goods is secured largely from a single area, the industry may be attracted there. These industries, therefore, tend to settle in large industrial centers which offer advantages both for the assembly of the varied materials and the distribution of the product. Where the product is more bulky than the materials from which it is made, the pull on the industry towards the market is likely to be especially strong.

Almost all plants must be located where they can be assured of a dependable and continuing supply of power. As long as this need can be met, relatively low power rates may not of themselves constitute a strong locational inducement since power is often a minor cost element. This is not true, however, of most electrometallurgical and electrochemical processes, such as aluminum reduction and the manufacture of abrasives. For these, plants have been established where power is available in its cheapest form, typically in the vicinity of favorable hydroelectric sites.

The increasing availability of cheap and rapid transportation has enabled industry to assemble a variety of materials from widely scattered sources and to distribute them to a wide market. Such transportation facilities have contributed to the development of mass production methods, and have promoted specialization of workers, plants, and regions. At the same time, improved transportation has provided locational freedom for industry and fostered industrial growth in areas distant from the sources of the basic raw materials.

An area lacking adequate transportation facilities cannot attract an industry manufacturing products using a great variety of materials and intended for an extensive market. It is important for such industries to locate where the aggregate costs of assembling materials and distributing products to the market will approach a minimum. If processing involves substantial loss of bulk for a major raw material this minimum point is likely to be nearer the source of materials. If it costs more to transport the finished product than the raw material the minimum point probably will be nearer the market. The greater the number of materials used, the greater is the likelihood that the point of minimum transportation costs will be close to the market or at some intermediate point between materials and markets rather than adjacent to any particular material. Obviously, the locational influence of low transportation costs may be outweighed by some other consideration. Thus, among alternative locations, one which provides a more abundant and cheaper supply of labor or power may be preferable, notwithstanding a disadvantage in transportation costs.

The point of minimum transportation costs in any instance, depends upon the rate structures of the available carriers. Thus, the fact that transportation rates are typically higher for finished goods than for raw materials tends to favor orientation of manufacturing towards the market. Claims have always been made that some areas have been favored and others prejudiced by the relationships between rates for different distances, directions, regions, or products. Every

change in these relationships may shift minimum-cost transportation points for some industries, and any special transportation privilege may affect locational patterns. The milling-in-transit practice, for example, has enabled intermediately situated flour mills to survive in competition with mills oriented with respect to either raw materials or markets. The locational effects of the development of motor trucking and of differences in rates for rail and highway carriage cannot be easily generalized. Broadly, however, it may be said that trucking has reduced rate differentials between fabricated products and raw materials and has thus tended to lessen the pull of the market on manufacturing; that highway transportation has diminished the ability of the railroads to manipulate rates so as to influence the location of light industry; and that the truck has added generally to industry's locational freedom by making nonrailway points accessible.

The quality, cost, and speed of passenger transportation also affect the location of economic activities. Improvements in all these directions, particularly through the universal use of the automobile, have eased the problem of labor supply for many industries by increasing the commutation radius for labor. They have also facilitated the establishment of manufacturing plants on the outskirts of cities. On the other hand, such improvements, by widening consumer markets, have diverted trade from small villages to towns and cities and have generally intensified the urbanization of industry. Among the considerations in the location of branch plants, the speed with which a busy executive can now reach them through the use of commercial or private planes may be important.

Producers sell their products directly to the ultimate consumers only to a relatively small extent. Goods are usually channeled through a succession of intermediate stages in the production process, and subsequently from producers to consumers through one or more middlemen. The development of this complex marketing organization—a development promoted by modern transportation—has enabled manufacturing industries to locate at a distance from resources and to serve wider markets. The elaboration of marketing machinery has thereby contributed to specialization in production and to the growth of industries which depend for their existence on ability to assemble at one point a number of materials drawn from scattered sources.

The market pattern is largely determined for producers by a variety of economic circumstances and forces over which they as individuals can exert little control. They must therefore take this pattern as given and, as far as may be necessary, adapt their location to it. Reference has already been made to a number of influences which tend to work for or against market orientation. But it must be borne in mind that manufacturing establishments as a rule sell their products to distributors or to other manufacturers. The industries which are market oriented are for the most part drawn toward such intermediate markets. Relatively few are tied directly to consumer markets; in the main these industries are producing consumer goods for which speed of delivery or close contact between producer and consumer are essential.

Plants which are under no physical necessity to locate near some natural resource or special market may be drawn to a particular location largely because of the presence of certain forms of skilled labor or of an abundant supply of relatively cheap labor. When an industry requiring considerable skilled labor has, for one reason or another, grown up in a certain area, the existence of a trained labor force may provide a major inducement for a new establishment in the industry to locate there. This inducement will be more powerful when the proportion of skilled workers to total labor needed is high, when the period needed to train new workers is long, and when there is little prospect of being able to dispense with skilled workers through technical innovations, and slight prospect that they can be induced to move. In all these respects, the trend has been to make labor orientation on the basis of skill a locational factor of decreasing importance in most manufacturing industries.

The existence of a potential labor force which is currently unutilized or underutilized may sometimes attract industries to particular locations. Thus, the establishment of silk mills in certain towns of the Pennsylvania anthracite region is largely attributable to the lack of employment opportunities for women in that region. Similarly, the presence of a surplus labor supply and the lack of sufficient employment opportunities in agriculture have tended to draw manufacturing plants to many small towns and rural areas.

The labor costs relevant to a locational decision are obviously costs per unit of output and not merely wage rates. But disparities in unit wage costs are ultimately an important locational consideration only insofar as they contribute to appreciable differences in the total cost of producing and supplying a unit of the product to the market. In areas where labor is relatively cheap, it is also likely to be relatively free from organized or legislative control. Both these characteristics have influenced the drift of certain industries, notably textiles from the North to the South.

Capital, in the sense of funds available for investment, is by far the most mobile of all the factors of production. Because capital tends to flow freely in search of the most profitable opportunities for employment, the question of its availability can often be

excluded from consideration in making a locational decision. The best way to attract capital is to make the choice which seems most promising on all other grounds. This is especially true where a large projected plant is able to secure funds from the open capital market through the flotation of securities for which a listing can be secured on a major stock exchange, for the location will normally be selected before the issue is placed on the market. Even if this has not been done, it is unlikely that any prospective investor or group of investors could influence the selection by making subscription to the issue contingent on the choice of one location rather than another. Occasionally, however, a small group owning a majority stock interest in an enterprise has been instrumental in expanding the enterprise at new locations which have been selected with greater regard to some special personal advantage than to any special benefit of the enterprise as a whole.

When the needed capital is too small for a public offering of securities, and an appeal to a local group or other selected individuals becomes necessary, the choice between a number of likely locations may fall on the place where the necessary capital is available on the most favorable terms. Under similar circumstances an investing group may occasionally require that the new facilities be placed near other operations in which they are interested. Investors who are asked to assume exceptional risks, such as those involved in financing the exploitation of most new inventions, may insist on a determining voice in the selection of a location for the venture.

Other Locational Factors

The location of industry cannot be considered solely from the point of view of production and distribution factors such as labor, power, materials, and markets. A number of influences spring from other factors, including the size and scope of firms and establishments, financial policies, monopolistic controls, pricing policies, and governmental and community policies.

The advantages of concentrating production in large plants, large firms, or large industrial centers vary from industry to industry. In general, a compromise must be sought between (1) the economies of greater specialization of operations, mass purchasing, centralized service, and availability of skilled labor, and (2) the diseconomies of complexity and inflexibility in large enterprises, as well as the high transport costs and rents likely to be associated with the centralization of operations. The relative force of these opposing considerations determines the typical size of plants, firms, and production centers in different industries and different regions. Where transportation costs are secondary and where advantages of centralization are great, the locational pattern is likely to consist of a few very large clusters of plants; where transportation costs on materials are dominant, plants are likely to be distributed regionally in relation to those materials, but with varying degrees of local concentration within the region. For industries in which delivery costs are relatively more important, plants are likely to be distributed in closer relation to markets, and the larger plants will be found concentrated locally in the heavier consuming areas.

The organization of production involves interproduct, interplant, and interfirm relationships which in turn condition the size of operations in making single products. The relationship between products is comparatively simple in cases where one product is the material, or can be used as a substitute for another or joins with it in the manufacture of a third product. Somewhat less obvious relationships exist between products which are economically produced in the same plant, firm, or location. Examples of these relationships include byproducts utilization and dovetailing of fluctuating labor or equipment requirements. The scale of operations and the locational pattern are likely to be modified by the advantages of combining operations in one plant or of integrating the units of one concern. Even in the latter case, the tendency is to bring operations closer together geographically.

A vertical integration of production occurs where two or more successive steps of a complex manufacturing process are consolidated. Economies of vertical integration in single firms are probably as great in the iron and steel industry as anywhere. Very few processes, however, show complete vertical integration in individual plants, partly because the forces of raw materials and markets often pull in opposite directions. The initial, weight-losing processing of a raw material pulls manufacturing operations toward raw-material sources, whereas the later stages involving increases in bulk, fragility, and transport costs generally cause manufacturing operations to gravitate toward consumer markets. Such are some of the influences operating on the location of industry through the economics of integration. These trends may work in different directions and degrees in different types of industry, and in some cases may offset one another.

Limitations upon competition in industries with few producers generally have the effect of curtailing total output and concentrating it at few locations. To the extent that combination reduces cross-hauling, it strengthens the market as a location factor. The control of secret or patented processes may give an established concern such a lead that subsequent competi-

tion is difficult, and locational cost differences become less significant. Partial or complete monopoly may also result from extensive economies of large-scale production in a given field. In either case, the element of monopoly control may mean that noneconomic forces or the desire to protect existing investment may for lengthy periods determine the pattern of location.

Pricing policies have an indirect but often important influence on location. In an imperfect market, caused in part by the geographic scatter of sellers, a single seller is able to influence the price at which his product is sold, particularly if the product is not standardized throughout the market. Price control under such circumstances influences the geographic distribution of producers, notably those of small capacity, as well as the distribution of industries purchasing from those producers. One important price policy which affects the location of producers is the establishment of a definite geographic system of delivered prices. Under such a system, producers may be able to locate at points which would not be economical under a system of prices established at the plant. Price policies may also affect the location of customer firms to the extent that these firms are oriented to the particular material to which the policies apply. Naturally, when a blanket delivered price is charged for a material, the fabricator using such material then has no important incentive to locate near its source. A multiple basing point system exerts a decentralizing force on fabricators, compared with the centralizing tendency of a single basing point system.

In the formulation of locational policy, it is pertinent to consider whether or not changes in the locational pattern of manufactures will adversely or favorably affect the welfare of small firms. It is a widely held belief that the concentration of industrial activity in a relatively few areas has greatly aggravated the sometimes precarious economic position of small firms and, therefore, that greater decentralization and diversification of industry in general are desirable. This point of view is not corroborated, however, by a study of the present geographical distribution of small manufacturing firms. While it is true that small-scale operations are characteristic of nonurban, nonindustrial areas, because they are designed to tap small pools of rural labor and because of a limited supply of materials or limited demand, such operations are also peculiarly adapted to certain kinds of manufacture in the major centers of industrial activity. If the manufacturing process requires relatively more labor than machinery or the product must undergo frequent style changes or is made for specialized customers, the scale of operations must frequently be kept small for maximum efficiency. Such firms can most economically be located in larger centers where there is an abundance of skilled labor, allied industries, and services.

The chief difficulties encountered by small firms are not locational in character. The stringency of capital and credit conditions, "unfair" competition on the part of large producers, lack of adequate research facilities, and, most recently, the inability to share extensively in the armaments program constitute the most imminent threats to small producers. These factors could not, in any considerable measure, be counteracted by encouraging a shift of industrial activity away from present centers.

Plant location is often influenced to some degree by the attractiveness of the community (including convenience of recreational, educational, and community facilities), by the promotional effort of interested local business and governmental groups, and by the availability of information concerning local resources.

Policy Considerations

The primary aim of a private industrialist in locating a plant is to select the location which will enable him to assemble materials, process them, and deliver the product to his customers at minimum cost. Sometimes the choice is relatively haphazard, but usually an effort is made to analyze the relative importance of each of the firm's production and distribution requirements and the costs of meeting them at various possible locations. The techniques of analysis, however, are often faulty and misleading, largely because the needed information is unavailable or obtainable only through a survey too costly for the majority of firms to undertake.

Government publications already contain considerable information helpful to producers seeking new locations. But the Government might well assemble and make available to such producers more needed information that cannot be obtained elsewhere. To the extent that such service would contribute to the more economic and efficient use of plant, labor, and materials, it would benefit not only individual enterprises but also the Nation at large.

The Federal Government has never played a neutral part in the determination of industry patterns. Most governmental measures have some influence on the use of resources and the growth of industry. Thus, minimum wage legislation and the protection of collective bargaining have helped to reduce wage-rate differentials between areas. The establishment of large public power projects has created low-cost power areas. Protective tariffs have aided certain industries and handicapped others. The impact of tax and expenditure policies has varied widely from region to region.

Such measures, in short, have affected the prices of goods and services, raising some and lowering others, and thereby increasing or decreasing the attractiveness of various possible locations for particular industries. But, although the locational potentialities of measures of this kind have sometimes been fairly well recognized, they have rarely been conceived as parts of a coordinated locational program designed to promote the most efficient utilization of our resources.

The need for developing such a public program is being increasingly felt, for, when peace returns, we shall be faced with problems of industrial readjustment and relocation hardly less difficult than those involved in mobilization for war. An effective program is likely to call for the employment of varied kinds of governmental action consistent with the spirit of our democracy and our system of free enterprise. This program will need to take full account of the effects of the war upon our economy, of the kind of world in which we are likely to find ourselves after the war, and of the nature and extent of our industrial readjustment problems. If the program is to be a useful guide for action, it must be based on careful analysis; it must look to long-term issues and not alone to the needs of the early post-war years of transition and reconstruction.

CHAPTER I. NATURAL RESOURCES—MINERALS

By Wilbert G. Fritz*

Volume of Raw Materials Derived From Resources

Economic activity consists in major part of efforts to convert resource materials into desired shapes, textures, sizes, combinations, and colors; to transport them to desired locations; to store them for suitable times of use; and to provide services, such as handling, selling, and repairing, in conjunction with them. Resources, therefore, are the starting point for a complicated succession of activities involved in industry. The tonnage of materials derived from resources is a rough common denominator for gauging the influence of those materials on industrial location, particularly with regard to their transfer from one area to another for the early stages of utilization.

The American economy produced in the aggregate 1,640 million tons of raw materials, or per capita 12.5 tons in 1939. This total includes products of agriculture, mining, forestry, and fishing, but it does not include such items as earth moved in grading and excavation, or water consumed or otherwise used (cf. tables 1, 2, and 3). The materials derived from natural resources were either consumed, added to the supply of goods, used in replacement of goods produced in previous years, or exported to foreign countries.

Agricultural production accounted for 1.2 tons of material per capita and of this the major crops, corn, cotton, hay, and wheat, constituted slightly less than 0.4 and dairy products 0.3 tons. Mineral materials were produced at a rate of 9.7 tons per capita, the larger components being coal 3.5 tons per capita, petroleum 1.5 tons, sand and gravel 1.5 tons, stone 1.1 tons, iron ore 0.5 ton, and copper ore 0.4 ton—other minerals combined amounted to only 1.2 tons. Forestry contributed per capita 1.7 tons of materials, more than half of which was fuel wood, whereas fishing supplied only a small fraction of a ton of materials per person. In addition, a relatively small tonnage of materials, not counted above, was obtained from abroad.

Locationally Significant Characteristics of Natural Resources

The type, volume, and location of resources are elements in the type, volume, and location of economic effort both in direct utilization of resources and in the more or less detached activities, such as services, that require a flow of commodities for their support. Into utilization enter human, organizational, and technological factors that account for the shaping of locational patterns in some degree on the basis of resources. It is therefore instructive to observe the characteristics of resources that play a part in location. These characteristics may be outlined as follows:

1. Uneven distribution geographically.
2. Fixed location.
3. Bulkiness in relation to value.
4. Difficult replacement or irreplaceability.
5. Large ratio of reserves to utilization.

From a locational standpoint, the striking feature of most resources, especially when qualitative factors are taken into account, is their geographic concentration. Iron ores, for example, are somewhat widely available, but only decidedly limited deposits are economically profitable to develop.

The extent to which location of industry is tied to resources is determined: (1) by the degree to which utilization is directly dependent on the location of the resources, and (2) by the influence of non-resource factors in the selection of resources not only as to kind but also as to extent of use. In numerous instances physically suitable resources are not used because of remoteness from markets, whereas in other instances inferior resources are intensively used because of pressing local needs.

The more advanced the industrialization of society, the greater is the probability of difference between the locational pattern of industry and the geographic spread of resources. Less effort, at least relatively, is spent in extractive activity, and more in transportation, processing and other handling.

An idea of the proportion of activity directly connected with resources can be derived from the distribution of gainful workers—those who report themselves employed or potentially employable—among industry groups. Data available in the decennial census of 1940 indicate that 19 percent of the persons in the gainfully occupied classification were in agriculture, forestry, and fishing, whereas only 2 percent were in mining. Most other gainful workers were in the commodity-producing industries, the raw materials for which could be transported away from the location of the originating resource, and in certain service industries that are collateral to commodity production. These small percentages for industries located close to resources

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TABLE 1.—*Weight and value of metallic ores produced in the United States, 1939*

Ore	Weight		Value	
	Short tons	Percent of total	Dollars	Percent of total
Total, all ores	162, 232, 064	100. 00	$675, 559, 579	100. 00
Antimony	3, 174	(2)	37, 200	. 01
Bauxite	420, 337	. 26	2, 166, 236	. 32
Chromite	4, 048	(2)	46, 892	. 01
Copper [1]	55, 221, 000	34. 04	[3] 148, 236, 000	21. 94
Gold and silver	19, 467, 000	12. 00	[3] 240, 593, 279	35. 61
Iron	61, 399, 060	37. 85	158, 511, 338	23. 46
Lead [1]	5, 387, 000	3. 32	[3] 39, 571, 000	5. 86
Lead-copper	8, 000	(2)	----------	----------
Magnesium	5, 325	(2)	[3] 2, 875, 533	. 42
Manganese	32, 824	. 02	2, 148, 321	. 32
Manganiferous	794, 357	. 49		
Mercury	[4] 708	(2)	[3] 1, 936, 714	. 29
Molybdenum	32, 347	. 02	22, 157, 000	3. 28
Selenium	[4] 173	(2)	[3] 605, 020	. 09
Tantalum	(5)	(2)	200	(2)
Tellurium	32	(2)	[3] 111, 004	. 02
Tin	38	(2)	[3] 38, 000	. 01
Tungsten	4, 287	(2)	4, 402, 182	. 65
Uranium and vanadium	279, 354	. 17	1, 053, 660	. 16
Zinc [1]	7, 576, 000	4. 67	[3] 51, 070, 000	7. 56
Zinc-lead	11, 518, 000	7. 10	----------	----------
Zinc-copper	67, 000	. 04	----------	----------
Zinc-lead-copper	12, 000	. 01	----------	----------

SOURCE: *Minerol Yearbook, 1940.*

[1] Refer also to the production figures for the complex lead, zinc, and copper ores.
[2] Less than 0.005 percent.
[3] Value of metal content of ore. Includes metal obtained from all complex ores. Value of ore figures not available separately.
[4] Metal content of ore. Ore figures not available.
[5] Less than one-half short ton.

TABLE 2.—*Weight and value of nonminerals produced for industry or direct human consumption, United States, 1939*

Material	Weight		Value	
	Short tons	Percent of group total	Dollars	Percent of group total
Agricultural materials [1]	150, 666, 000	100. 0	$8, 855, 344, 000	100. 0
Crops	97, 708, 000	64. 9	3, 574, 669. 000	40. 4
Corn	16, 716, 000	11. 1	338, 503, 000	3. 8
Wheat	19, 134, 000	12. 7	440, 709, 000	5. 0
Oats	2, 354, 000	1. 6	45, 762, 000	0. 5
Barley	2, 373, 000	1. 6	39, 842, 000	0. 5
Rice	1, 021, 000	0. 7	33, 022, 000	0. 4
Flaxseed	517, 000	0. 3	26, 950, 000	0. 3
Other grains	984, 000	0. 6	17, 676, 000	0. 2
Cotton lint	2, 954, 000	2. 0	550, 046, 000	6. 2
Cottonseed	4, 500, 000	3. 0	78, 529, 000	0. 9
Tobacco	929, 000	0. 6	268, 597, 000	3. 0
Potatoes	10, 140, 000	6. 7	199, 522, 000	2. 3
Sweet potatoes	1, 610, 000	1. 1	44, 260, 000	0. 5
Dry edible beans and soybeans	2, 603, 000	1. 7	89, 685, 000	1. 0
Peanuts	400, 000	0. 3	36, 550, 000	0. 4
Sugars and sirups	2. 475, 000	1. 6	86, 991, 000	1. 0
Truck crops	10, 029, 000	6. 7	534, 045, 000	6. 0
Citrus fruits	4, 763, 000	3. 2	133, 004, 000	1. 5
Apples	4, 376, 000	2. 9	116, 703, 000	1. 3
Other fruits	6, 132, 000	4. 1	130, 389, 000	1. 5
Berries	380, 000	0. 2	60, 311, 000	0. 7
Tree nuts	114, 000	0. 1	20, 573, 000	0. 2
Other crops	3, 204, 000	2. 1	283, 000, 000	3. 2
Livestock and livestock products	52, 958, 000	35. 1	5, 280, 675, 000	59. 6
Cattle and calves	7, 506, 000	5. 0	1, 301, 226, 000	14. 7
Hogs	8, 580, 000	5. 7	979, 940, 000	11. 1
Sheep and lambs	1, 077, 000	0. 7	182, 090, 000	2. 1
Chickens	1, 400, 000	0. 9	347, 868, 000	3. 9
Turkeys	233, 000	0. 2	72, 546, 000	0. 8
Eggs (chicken)	2, 328, 000	1. 5	540, 197, 000	6. 1
Dairy products	31, 485, 000	20. 9	1, 723, 484, 000	19. 5
Wool	189, 000	0. 1	84, 324, 000	0. 9
Other	160, 000	0. 1	49, 000, 000	0. 5
Forest products [2]	176, 468, 000	100. 0	504, 650, 000	100. 0
Fuel wood	113, 089, 000	64. 1	197, 000, 000	39. 0
Lumber	32, 968, 000	18. 7	179, 825, 000	35. 6
Pulpwood	9, 834, 000	5. 6	38, 950, 000	7. 7
Fence posts	9, 005, 000	5. 1	20, 000, 000	4. 0
Other	11, 572, 000	6. 5	68, 875, 000	13. 7
Fish	2, 222, 000	100. 0	96, 532, 000	100. 0

[1] Value data for agricultural materials are based on cash income from farm marketings plus the value of commodities used for human consumption on the farms. Crops exclude those fed to livestock and seeds used for reseeding. Livestock and livestock products exclude draft animals.
[2] Crude materials only.

TABLE 3.—*Weight and value of nonmetallic minerals produced in the United States, 1939*

Mineral	Weight		Value	
	Short tons	Percent of total	Dollars	Percent of total
All nonmetals	1, 062, 372, 964	100. 00	3, 510, 770, 856	100. 00
Arsenious oxide	22, 439	(1)	495, 500	. 01
Asbestos	15, 459	(1)	512, 788	. 01
Asphalt, native	459, 848	. 05	3, 066, 844	. 09
Barite, crude	383, 609	. 04	2, 344, 103	. 07
Borates, natural	249, 976	. 02	5, 882, 302	. 17
Bromine	18, 941	(1)	7, 611, 400	. 22
Calcium-magnesium chloride	108, 441	. 01	1, 307, 717	. 04
Cement	23, 510, 640	2. 21	184, 254, 932	5. 25
Clay, raw	[2] 20, 371, 393	1. 92	[2] 83, 176, 398	2. 37
Coal, bituminous	393, 065, 000	37. 00	732, 534, 000	20. 87
Coal, anthracite	51, 487, 377	4. 85	187, 175, 000	5. 25
Diatomite	90, 000	. 01	[2] 1, 409, 000	. 04
Emery	765	(1)	6, 828	(1)
Felspar, crude	283, 882	. 03	1, 112, 857	. 03
Fluorspar	182, 771	. 02	3, 704, 959	. 11
Fuller's earth	167, 070	. 02	1, 691, 855	. 05
Garnet, abrasive	4, 056	(1)	278, 534	. 01
Graphite	[2] 500	(1)	[2] 56, 000	(1)
Grindstones and pulpstones	10, 434	(1)	426, 375	. 01
Gypsum, crude	3, 226, 737	. 30	4, 431, 005	. 13
Helium	(3)		75, 262	(1)
Iodine	[2] 300	(1)	[2] 600, 000	. 02
Kyanite	2, 950	(1)	69, 000	(1)
Lime	4, 254, 348	. 40	30, 049, 394	. 86
Lithium minerals	1, 990	(1)	97, 000	(1)
Magnesite, crude	198, 980	. 02	1, 465, 190	. 04
Magnesium oxide and salts	85, 754	. 01	1, 907, 944	. 05
Marl, calcareous	22, 114	(1)	38, 492	(1)
Marl, greensand	6, 466	(1)	150, 500	(1)
Mica, sheet and scrap	25, 079	(1)	450, 858	. 01
Natural gas	(3)	(1)	539, 625, 000	15. 37
Natural gasoline	5, 883, 026	. 56	94, 300, 000	2. 69
Oilstones and related products	620	(1)	115, 805	(1)
Olivine	3, 000	(1)	15, 000	(1)
Peat	55, 483	. 01	362, 066	. 01
Petroleum	195, 201, 632	18. 38	1, 265, 000, 000	36. 03
Phosphate rock	4, 207, 915	. 40	12, 294, 042	. 35
Potassium salts	366, 287	. 03	12, 028, 195	. 34
Pumice	89, 159	. 01	424, 780	. 01
Pyrites	578, 377	. 05	1, 550, 449	. 05
Salt (sodium chloride)	9, 277, 911	. 87	24, 509, 680	. 70
Sand, glass	2, 468, 290	. 23	4, 280, 936	. 12
Sand and gravel (building)	192, 350, 243	18. 11	90, 943, 111	2. 59
Silica (quartz)	34, 959	(1)	153, 038	(1)
Slate	531, 380	. 05	6, 682, 214	. 19
Sodium salts (natural carbonates and sulphates)	262, 222	. 02	2, 556, 686	. 07
Stone	147, 447, 130	13. 88	158, 461, 515	4. 51
Sulfur	2, 501, 875	. 24	35, 500, 000	1. 01
Talc, and ground soapstones	253, 967	. 22	2, 700, 834	. 08
Tripoli	33, 474	(1)	466, 380	. 01
Vermiculite	21, 174	(1)	174, 587	. 01
Natural sulfonated bitumen chats	2, 237, 000	. 21	314, 200	. 01
Pebbles for grinding	310, 512	. 03	1, 930, 301	. 06

SOURCE: *Minerols Yeorbook, 1940;* data for estimating the total weight and value of clay produced in the United States were obtained from the Structural Clay Products Institute, the Tile Manufacturers, Association, and the reports of the Bureau of the Census. The value of clay was estimated by using the average price per ton of the raw clay reported in *Minerals Yeorbook* as sold by producers in 1939.

[1] Less than 0.005 percent.
[2] Estimated.
[3] Comparable weights for gases have not been calculated. The quantity of helium gas produced in 1939 was 6,281,800 cubic feet; the quantity of natural gas was 2,435-000, 000, 000 cubic feet.

reflect a wide latitude for activities which, because of factors to be discussed in other chapters of this report, may be attracted to areas away from the resources. It does not follow, of course, that all such activities will be at a distance. On the contrary, resources are an attractive force that determine location unless other factors produce a net advantage for outside areas.

Geographic Elements

Geographic elements affecting location of industry may be classified into: (1) physical features, and (2)

resources contributing to or providing mineral and nonmineral (largely agricultural) materials. These types are not in all instances mutually exclusive. Physical features determine in part the availability of either minerals or nonminerals for use in industry. Rough terrain, for example, may make difficult or preclude mining operations or it may reduce productivity in agriculture. Weather affects not only the kind and volume of agricultural output, but also the cost of mining and manufacturing. A rigorous climate may be unfavorable to operations that must be out-of-doors, that require large building space, or that require special protection from the elements.

Physical Features Affecting Location

Land contour, atmospheric temperatures, humidity, precipitation, waterways, and type of soil have locational repercussions. Approximately two-fifths of the total land area of continental United States is characterized by rough mountainous or hilly terrain (fig. 1). These areas present obstacles to the location of industry by acting as barriers to transportation, by forcing industry into deep, narrow valleys or out into certain accessible flat areas, and by presenting generally unfavorable conditions for farming. However, they contain most of the potential water power, a large part of the mineral resources (notably metallic minerals and high-rank coal), and most of the forests.

Topography

The Appalachian Mountains have had a substantial influence on the locational patterns of industry in the eastern half of the United States. They gave certain areas the impetus of an early start dating back to colonial times when waterways were the chief routes of transportation and when overland routes, especially in timbered areas, were exceedingly difficult to traverse. They also contained waterpower for the initial application of mechanical energy in industry. In the colonial period, settlement was in a narrow strip of land along the Atlantic Coast. The early population patterns have persisted, although the proportion in urban centers has increased. Large cities have developed at the main coastal inlets and numerous medium-sized cities in other locations, particularly at the fall line where waterpower and the terminus of water trans-

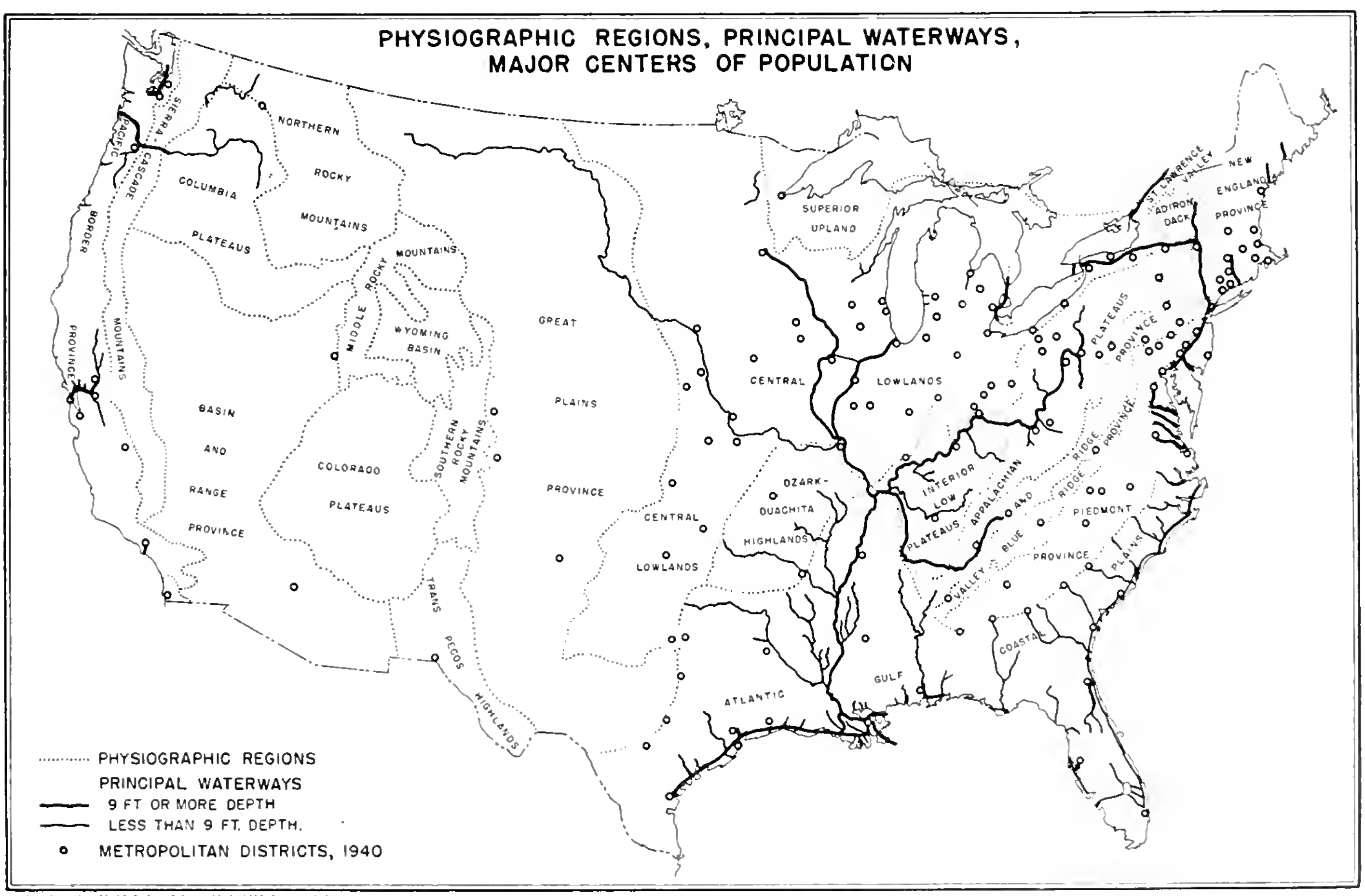

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FIGURE 1

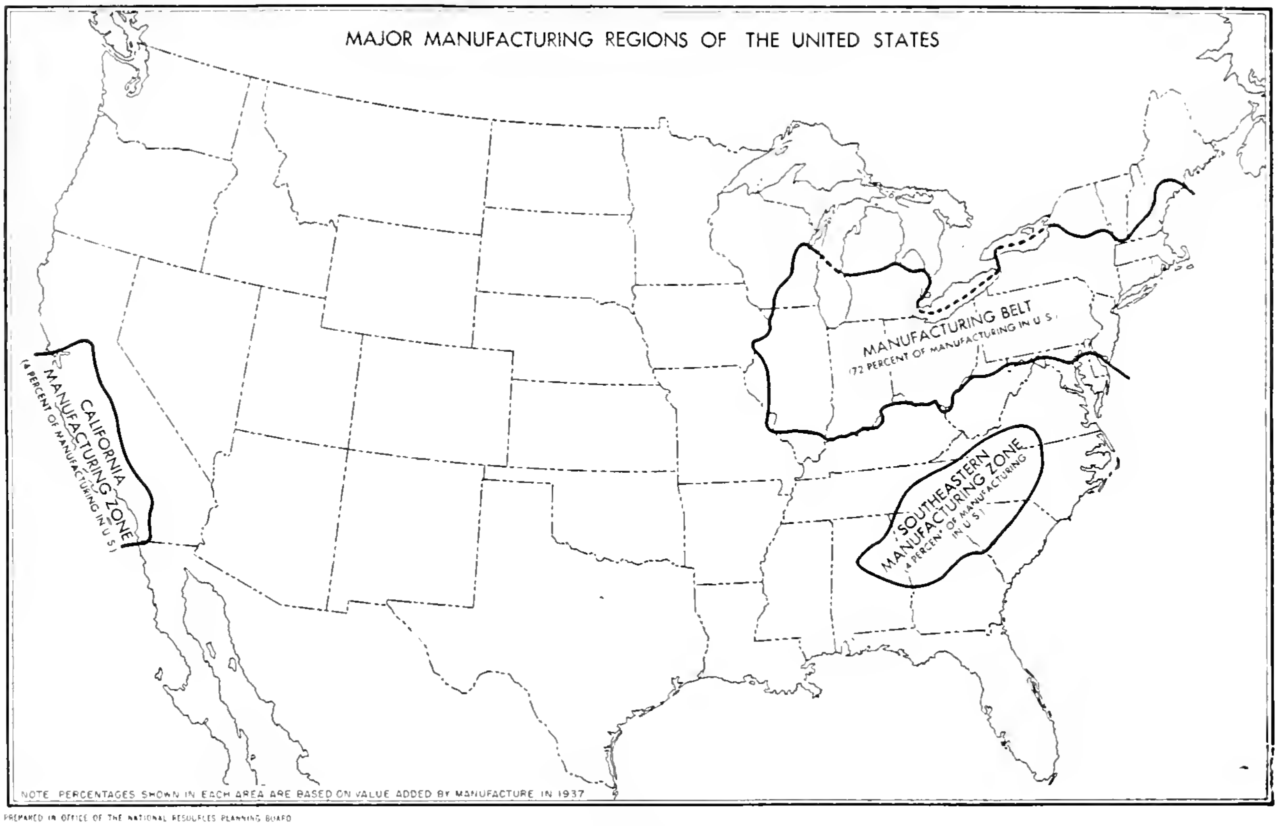

FIGURE 2

portation encouraged urban settlement. Railroads and highways have made possible the development of other centers, such as Fitchburg, Mass., York, Pa., and Greensboro, N. C., but in the main these transportation routes have been focused on existing major centers.

With some exceptions, notably in eastern Pennsylvania and the Shenandoah Valley, the land east of the Appalachian Mountains is relatively infertile. Rich agricultural lands west of the mountains had a decidedly adverse effect as soon as railroads and canals were built, and immediately to the west the mountains helped to channel industry into the Erie Canal Belt, the shores of Lake Ontario and Lake Erie, and the Upper Ohio Valley. From these localized areas the region of industrial concentration spreads out between the Great Lakes and the Ohio River.

States north of the Potomac and Ohio Rivers and east of the Mississippi River contain only 14 percent of the land area of the United States but 50 percent of the population (1940) and 75 percent of the value added by manufacture (1937). A narrower zone, which may be designated as the manufacturing belt, contains only 9 percent of the country's land area but 48 percent of the population and 72 percent of the value added by manufacture (fig. 2). The periphery of the zone touches, on the south and west, points along the Potomac, Ohio, and middle Mississippi Rivers, and, on the north, large urban centers in southern Wisconsin and Michigan, the Erie Canal Belt, Massachusetts, southern New Hampshire, and Maine. In contrast, the Southern manufacturing zone contains 3 percent of the area, 5 percent of the population, and 4 percent of the value added by manufacture; the Pacific Coast manufacturing zone contains 2 percent of the area, 5 percent of the population, and 4 percent of the value added by manufacture.

Topography, of course, has not been the sole resource determinant of the manufacturing belt. Others will be considered later. But it may be noted here that, although the manufacturing belt contained 72 percent of the manufacturing in 1937, it had only 40 percent of the agricultural income, 25 percent of the value of all minerals produced (only 20 percent excluding coal), and less than 15 percent of the lumber.

Despite the fact that these percentages for materials are lower than the proportion for manufacturing, they are above average in terms of area. It does not follow that the concentration of basic materials must be above that for manufacturing to account primarily for concentration in manufacturing. Very likely a slight superiority of one area in resources may lead to a marked superiority in manufacturing. One advantage of an area may set in motion an accumulation of other advantages. The extent to which this

may be carried will depend in major degree on the advantages of centralized industry, for without such advantages there would be no incentive to concentrate beyond that of resources. Centralization, of course, may be stimulated or retarded by arbitrary means.

Widely scattered urban centers are characteristic of the States bordering along the Mississippi River, although Chicago resembles the large centers along the Atlantic coast in that it is located on a main water route that acts as a barrier to land transportion. The semiarid Great Plains region has no cities of size except Amarillo, Tex., and cities at the eastern edge of the Rocky Mountains. The Inter-Mountain region has an extremely uneven distribution of industry—marked concentration at scattered points—and sparse agriculture except in irrigated areas. Along the Pacific coast, the Atlantic coast type of location with respect to physical factors is repeated.

Waterways

The influence of waterways on location of industry has been considerable. Narrow areas along the Atlantic coast and the Great Lakes include a major share of the large metropolitan centers of the country even though such centers are seldom surrounded by tributary land areas on which they may draw for regional trade. Most other major centers are located on the principal rivers, although Indianapolis, Denver, Columbus (Ohio), and Atlanta are outstanding examples of cities not on major waterways.

Waterways affect location by acting both as impediments and as inducements to commerce. A sizeable stream may force land transportation to seek certain routes in order to find suitable crossings, if indeed a crossing can be found at a reasonable expenditure. Once a crossing has been established, the convergence of trade tends to be self-reinforcing and to call for further ferries or bridges. St. Louis and Memphis have been given a strong impetus by this convergence of trade routes. The belated settlement of Oklahoma seems to have been connected in part with the impediment to land transportation presented by the Mississippi River and flood plain. Settlement was shunted north and west of St. Louis or south along the Gulf Coast where water transportation could be used.

Although the streams are less formidable barriers now than in earlier years, they have by no means a negligible effect in concentrating development in existing centers or in new centers that happen to lie along certain alternate routes. Physical factors affecting coastal cities are usually far less amenable to modification than those affecting inland cities; nevertheless, changes are possible by the construction of bridges or tunnels, as at New York City and San Francisco.

Mountain Barriers

The locational effect of mountain barriers is similar to that of waterways inasmuch as they help to concentrate development at selected points. The localization of industry in the mountainous areas is notably associated with terrain not only at the urban sites but also with respect to transportation routes. Both Denver and Atlanta, cited above as examples of cities not located on major rivers, are in marked degree the result of channeling of trade around mountain barriers.

In general, mountains offer more impediment to location and less inducement than waterways. In fact, waterways have exerted and continue to exert a strong pull on commerce by providing low-cost routes for transportation, and by encouraging freight-rate structures favorable to centers along the water routes. Especially noteworthy is the bearing of coastal routes, the Hudson River, the Erie Canal, the Great Lakes, the Ohio River, and the lower Mississippi River on the land transportation patterns and the freight-rate structure.

Water Resources

Water resources also enter into location of industry because of needs for agricultural production, nonagricultural industry, and domestic (household) consumption. Supplies ultimately depend on precipitation, evaporation, and reserves of surface water and ground water. Large quantities of water, of course, flow on the surface or underground from one area to another, and, therefore, interregional aspects are brought into play. It is coming to be recognized increasingly that water supply, far from being a local problem, is one that involves interests of competing areas. Originally, natural factors of storage, gradient, and evaporation determined the places in which and the periods of time for which water, derived from precipitation at equal or higher levels of altitudes, would be available. With the growth of industry and population, modifications have been introduced. Water is diverted, stored, consumed, and polluted in such vast quantities that controls have become necessary. Public water systems in cities of 20,000 or more population delivered in 1936 at least 11 billion tons of water, a weight about seven times as large as that of all other raw materials produced in the nation. It is not uncommon for urban areas to use the equivalent flow of a sizable river. New York, San Francisco, and Los Angeles have had to reach out at great expense to distant watersheds.

Water supply has far greater effects on industry than that on agriculture alone through direct use as a commodity, use in processing and treating, and application in cooling and humidification. Much of the

water used by industry is not obtained from public water systems. If a plant uses large amounts of water, it will be located at or near a body of water or where abundant supplies are available from wells. All large electric power plants, except Diesel plants, for example, must be on rivers or fresh-water lakes. Thus the options for location are greatly reduced. Even where there is a supply of water, location of plants may be vetoed because of restrictions on use for sanitary, recreational, or other reasons, qualitative deficiencies of the water, or competitive use by other plants. A good example of an abundance of water not available at many sites is in Chicago, where virtually all the lake front is publicly owned.

Water supply, therefore, involves a wide range of aspects, but behind all considerations is the limitation on supply fixed by the precipitation (see fig. 3). Elements of control for better use include improvement of ground cover, soil conservation, and regulation of stream flow. Irrigation projects, flood prevention, hydroelectric power generation, and navigation substantially affect the location of industry. Water supply is generally a small cost item for enterprise, but gigantic social costs are being incurred to accommodate water resources to needs.

Temperature

Temperature as a factor in location of industry sometimes plays a dominant role, although its influence outside the field of agriculture is usually limited. The citrus-fruit industry and numerous activities in connection with it must necessarily be in the southern regions—almost entirely in California, southern Texas, and Florida—where freezing temperatures are rare or nonexistent (cf. fig. 4). Cotton production is limited to southern areas that have about 200 or more days average frost-free season. On the other hand, the cool climate of the northern States is favorable to production of hay and dairy products. Creameries, cheese factories, and condensed and evaporated milk plants are located close to the source of supply. Almost two-thirds of the cheese manufacture is in Wisconsin and New York. The industry, however, has been spreading to other States which have increased their share from about one-fourth in 1930 to approximately one-third, gains having been especially rapid in the cotton belt. Butter production and condensing of milk are concentrated in the northern grass-land areas but less so than cheese production. The development of early maturing corn has extended corn production into Minnesota and other northern States.

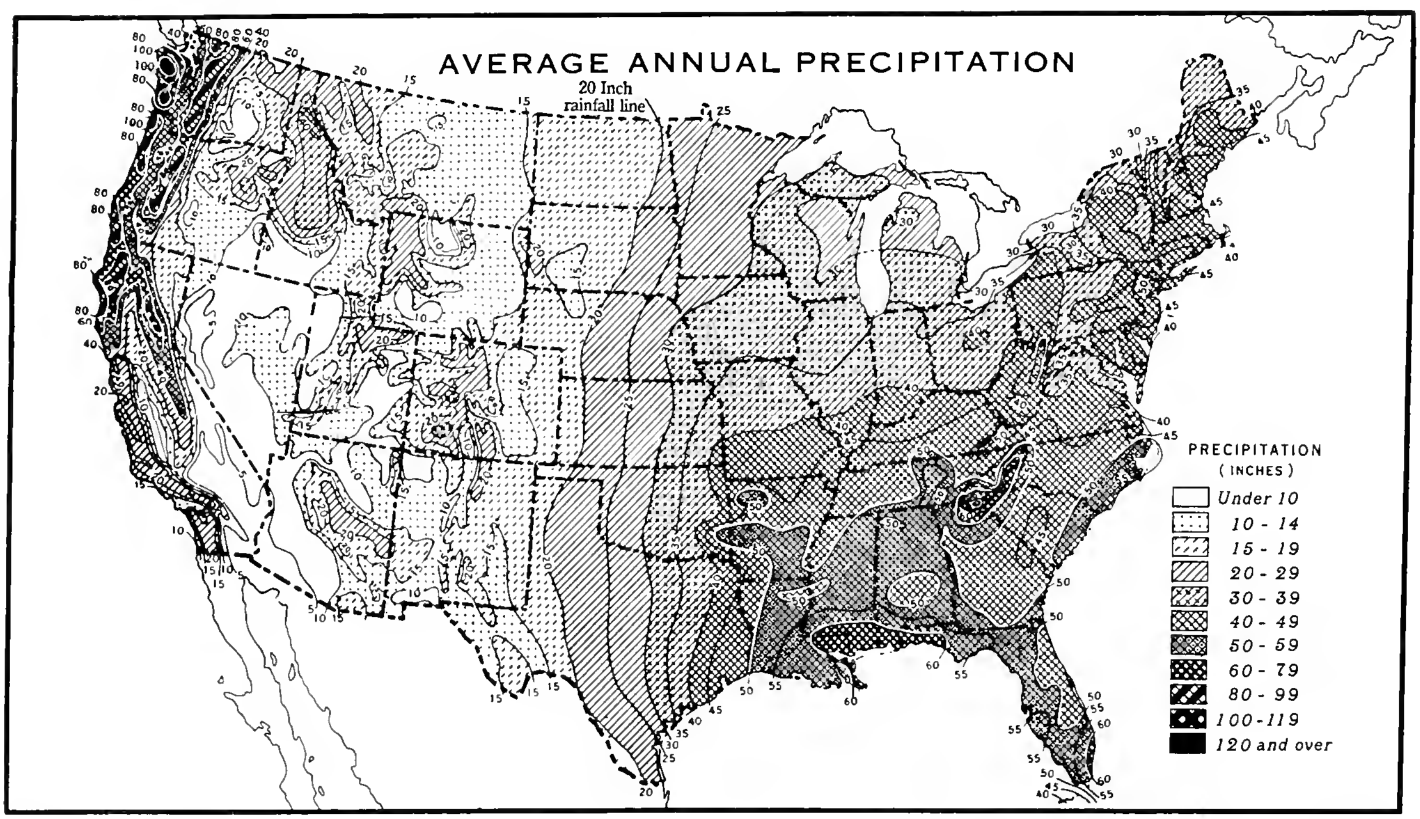

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FIGURE 3

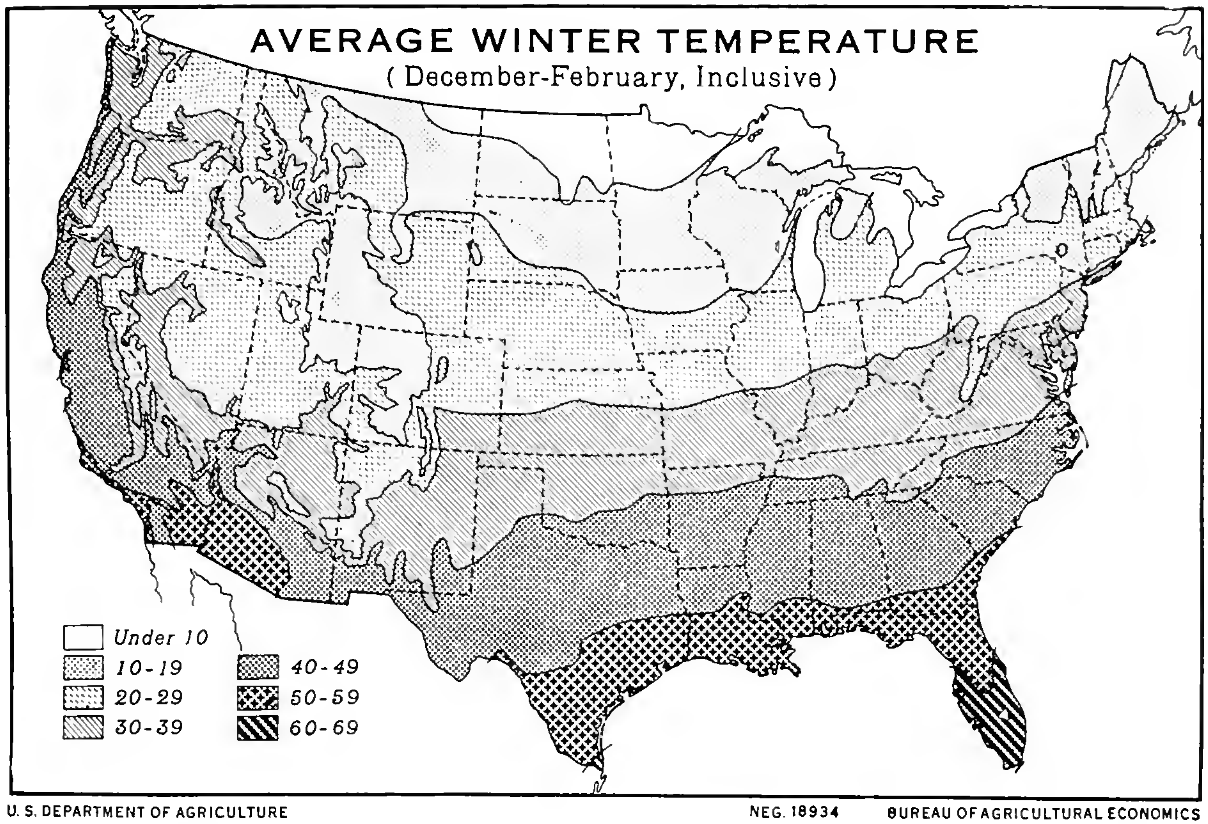


FIGURE 4

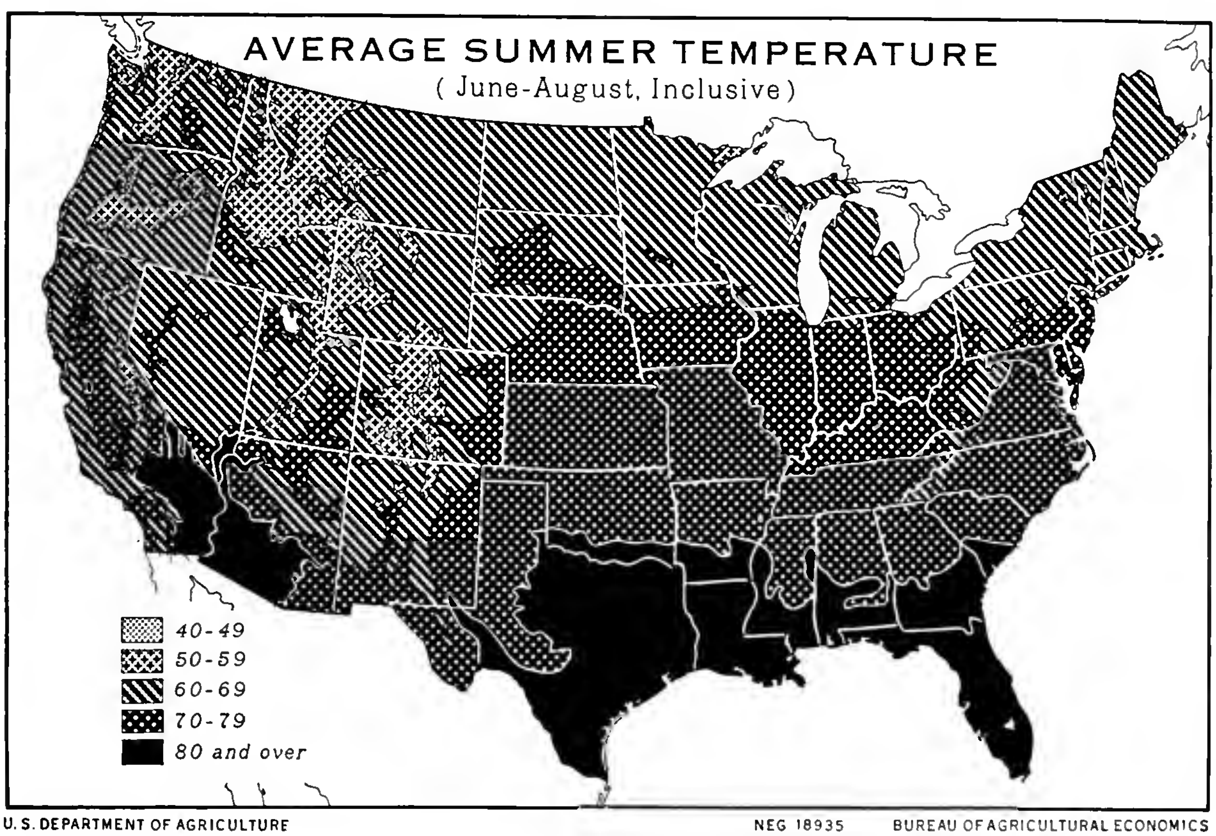


FIGURE 5

Certain outdoor production, e. g., shipbuilding, can be carried on more favorably if winters are not rigorous. Likewise, activities such as aircraft assembly, requiring large building space, may best be located in areas of temperate climate. On the other hand, high atmospheric temperatures, especially if combined with high humidity, are likely to slow down production or to require expenditures for protection from the heat (cf. fig. 5). One reason often cited for the location of the textile industry in New England is the existence of a cool, moist climate which makes the yarn more pliable and less likely to break. Excessive heat is often a problem in steel mills and machine shops.

It should be noted that high summer temperatures are not limited to southern States. Northern States, especially those in the Great Plains area and the basin areas of the Rocky Mountains, may have high temperatures, although the season of hot weather is short. Areas with wide annual extremes of heat and cold may be unfavorable to location of industries. No doubt the even climate of the Los Angeles area makes it attractive for the motion picture industry.

The locational significance of temperature is being lessened by the introduction of air-conditioning. Year-around temperature control may be combined with air purification, humidity control, and artificial lighting arrangements, so that the costs of installation and operation can be distributed among multiple benefits. Windowless plants incorporating these features permit greater freedom in location.

Land Resources

Land resources are a factor in location, because they have direct effects as well as because they are a source of minerals and a base element in agricultural production. The exact selection of a site may be determined by subsurface features, e. g., the strength of the strata for supporting the weight of buildings and equipment or for preventing vibration of machinery. This factor may cause a plant to be located on another site possibly in another area. Hydroelectric plant locations are in many instances governed by the extent to which the underlying strata are capable of supporting the dam structure under the high pressure of the water held back. In less specialized cases subsurface features are usually a less critical consideration in location. In fact, engineering techniques make possible the support of skyscrapers on floating foundations sunk into comparatively loose subsurface material.

Land-space considerations are almost always significant in the location of plants both within and among urban areas as well as in the weighing of the merits of urban as against rural sites. Competition for land areas is a universal factor that must be faced in the selection of a plant location and in the distribution of supporting population. Land-investment economies of dispersion must be compared with the advantages of location where competition for land space is stiff, but where there may be access to desired facilities. The land-space problem is made more difficult by the inability of most urban areas to spread out with ease in all directions. As a rule the most congested district in an urban area is off center, owing to the influence of waterways, terrain, or the layout of transportation. Competition for locations is more focalized than it would be with alternative locations in more directions. The most extreme case of focalization is found on Manhattan Island, but San Francisco, Seattle, Galveston, New Orleans, Charleston (S. C.), and Norfolk have similar problems.

Mineral Resources

For the purpose of investigating industrial location, natural resources may be divided into metallic minerals; nonmetallic minerals, including coal, petroleum, and natural gas; agricultural resources; forests; and marine life. Mineral resources, which comprise the first two classes, are almost wholly extractive in character. These sources cannot be replenished at a sufficient rate to be of consequence in the calculations of supply. From a practical standpoint, the resources will be depleted with each increment of use or waste.

Nonmineral resources, unlike mineral resources, are connected with industry through the production of living matter for use as materials. The use may be direct, as in the case of many fruits and vegetables, or it may be indirect, as in the case of most woods, fibers, and vegetable oils. These nonmineral resources are replenishable at variable rates. Replenishment of cultivated crops may proceed rapidly, whereas replenishment of forests and animals which require a long period for the life cycle will consume a longer interval. To the extent that plant and animal tissues are derived from water and elements in the atmosphere, no problem of long-term depletion exists. The tissues, however, contain valuable minerals from the soil, minerals that may have to be replaced for continued production. A chief difference between agriculture and mining is that mineral matter for plants need not be highly concentrated; in fact an overconcentration of certain minerals, such as phosphorus, would be fatal to growth. On the other hand, the problem of utilization of minerals is in large part one of concentration. The reason why Lake Superior district iron ores are used, for example, in preference to the more abundant ores of the Appalachian region is that they are more concentrated. Areas lacking concentrated minerals must be largely agricultural or dependent on importation of mineral supplies for the support of industrial activity.

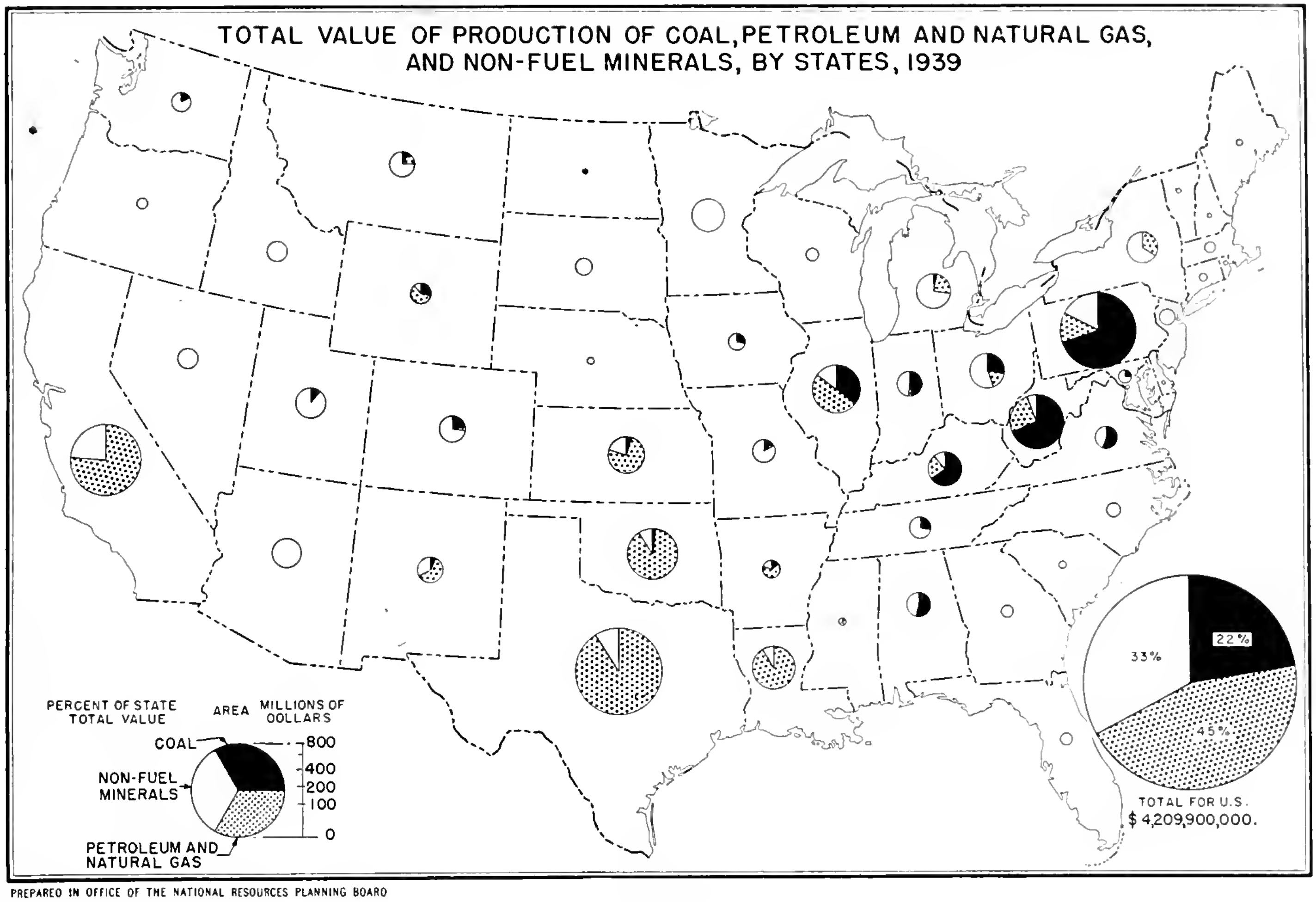


FIGURE 6

It should not be assumed, of course, that the currently known supplies or the present methods of utilization set an absolute limit on the quantity of mineral resources available for industry. Each year discoveries add to known reserves. Particularly noteworthy are the additions to known reserves of petroleum, gas, and rare metals. On the other hand, few discoveries of importance have been made in recent years of coal, iron ore, copper, zinc, and lead. One may observe that the more accessible minerals are likely already to have been found and that future discoveries may yield smaller returns in terms of consumption standards. There are also possibilities of intensive expansion through the development of processes for utilization of lower-grade minerals. Inventions, such as the cyanide process used in gold mining and the byproduct process for coke production, have increased the range of resources that are commercially workable. A similar result is the reduction of minerals discarded as waste. Large quantities of coal, copper, zinc, lead, and other minerals are now being recovered that in earlier years would have been cast aside.

Qualitative variability of mineral resources, therefore, is a significant aspect of their relationship to location of industry. The study of mineral resources as factors in location should go beyond the existing patterns of use. It should indicate possibilities latent within modifications of the patterns as well as weigh the merits of the present adjustments to environment. The extraction of minerals is considerably more concentrated than the resources from which supplies are drawn. This is especially true of certain minerals, such as coal, stone, sand, and gravel, which are widely dispersed. Because of geographic variability of industry differing from that of mineral resources, or for other reasons, the rate of exploitation is not uniform. Given a large expanse of mineral resources, an enterpriser has the choice of using supplies at one location or another. In other words, a question of selection arises to change the locational pattern from that of the resources in addition to the modifications dictated by nonresource considerations.

Shifts of industry, which reflect in part readjustments to resources, are not now so obvious as they

TABLE 4.—*Mineral products of the United States and principal producing States (and Alaska) in order of quantity produced, 1939*

Mineral product	States and their percentage of United States total production
Aluminum	New York,[1] Tennessee,[1] North Carolina.[1]
Andalusite	California,[1] Nevada.[1]
Antimonial lead	Not separable by States.
Antimony ore	Idaho (84.3), Alaska,[1] California,[1] Nevada (4.3).
Aplite	Virginia.[1]
Arsenious oxide	Montana,[1] Utah.[1]
Asbestos	Vermont,[1] Arizona (5.8), Georgia and North Carolina,[1] Maryland.[1]
Asphalt, native	Texas (30.2), Kentucky,[1] Oklahoma,[1] Alabama.[1]
Asphalt, oil	Not separable by States.
Barite, crude	Missouri (44.7), Georgia (22.6), Tennessee (14.9), California.[1]
Bauxite	Arkansas (96.3), Alabama,[1] Georgia.[1]
Bismuth	Not separable by States.
Bitumen, natural sulfonated	Utah.[1]
Boron minerals	California (99.9), Nevada (0.1).
Bromine	North Carolina,[1] Michigan (34.4), California,[1] West Virginia (2.3).
Cadmium	Not separable by States.
Calcite (Iceland spar)	New Mexico.[1]
Calcium-magnesium chloride	Michigan (90.7), West Virginia (11.1), Ohio.[1]
Cement	Pennsylvania (20.3), California, (9.1), Michigan (6.7), New York (5.6).
Chats	Oklahoma (74.3), Missouri (23.4), Kansas (2.2).
Chromite	California (97.2), Oregon (2.8).
Clay products	Ohio,[1] Pennsylvania,[1] California,[1] Illinois.[1]
Clay, raw	Pennsylvania (17.7), Georgia (14.2), Ohio (12.5), Missouri (10.2).
Coal, bituminous	West Virginia (27.5), Pennsylvania (23.5), Illinois (11.8), Kentucky (10.9).
Coal, Pennsylvania anthracite	Pennsylvania (100.0).
Coke	Pennsylvania (27.3), Ohio (13.8), Indiana (11.0), New York (10.1).
Copper	Arizona (36.8), Utah (24.1), Montana (13.7), Nevada (9.3).
Diatomite	California,[1] Oregon,[1] Washington,[1] Nevada.[1]
Dumortierite	Nevada.[1]
Emery	New York (100.0).
Feldspar, crude	North Carolina (30.3), South Dakota (19.1), New Hampshire (13.6), Colorado (11.8).
Ferroalloys	Pennsylvania (34.2), New York (19.5), Ohio (17.1), West Virginia.[1]
Flintlining for tube mills	Minnesota.[1]
Fluorspar	Kentucky (49.0), Illinois (41.2), Colorado (4.1), New Mexico.[1]
Fuller's earth	Georgia,[1] Texas (22.9), Florida,[1] Illinois.[1]
Garnet, abrasive	New York,[1] North Carolina,[1] New Hampshire,[1] Vermont.[1]
Gold	California (25.6), Alaska (12.1), South Dakota (11.0), Colorado (6.5).
Amorphous graphite	Nevada,[1] Georgia.[1]
Crystalline graphite	New York.[1]
Grindstones and pulpstones	Ohio (72.1), West Virginia (25.9), Washington.[1]
Gypsum, crude	New York (22.0), Michigan (19.9), Iowa (13.3), Texas (8.8).
Helium	Texas (100.0).
Iodine, natural	California.[1]
Iron ore	Minnesota (59.0), Michigan (20.5), Alabama (10.9), Pennsylvania.[1]
Pig iron	Pennsylvania (28.0), Ohio (22.6), Indiana (10.5), Illinois (8.9).
Sinter iron	Tennessee.[1]
Kyanite	California,[1] Georgia,[1] Virginia,[1] North Carolina.[1]
Lead	Missouri (37.1), Idaho (21.6), Utah (16.1), Oklahoma (6.6).
Lime	Ohio (26.0), Pennsylvania (16.3), Missouri (12.2), West Virginia (5.9).
Lithium minerals	South Dakota (87.4), California.[1]
Magnesite, crude	Washington,[1] California,[1] Nevada,[1] Vermont.[1]
Magnesium	Michigan (100.0).
Magnesium salts, natural	Michigan,[1] Nevada,[1] California,[1] Washington.[1]
Manganese ore	Montana (38.0), Tennessee (26.7), Arkansas (18.3), Georgia (9.0).
Manganiferous ore	Minnesota (91.9), New Mexico (4.5), Colorado (1.1) Georgia (1.0).
Manganiferous zinc residium	New Jersey.[1]
Calcareous marl	West Virginia,[1] Virginia (40.1), Nevada,[1] Minnesota (3.6).
Greensand marl	New Jersey (100.0).
Mercury	California (59.7), Oregon (24.6), Idaho,[1] Nevada (4.4).
Mica, scrap	North Carolina (56.4), Georgia,[1] Virginia,[1] California.[1]
Mica, sheet	North Carolina (49.3), Connecticut,[1] South Dakota,[1] New Hampshire (5.4).
Mineral paints (zinc and lead pigments).	Pennsylvania,[1] Illinois,[1] Kansas,[1] Indiana.[1]
Molybdenum	Colorado (78.5), Utah (15.3), New Mexico (3.9), Arizona (2.2).
Natural gas	Texas (39.5), California (14.1), Louisiana (11.9), Oklahoma (10.1).
Natural gasoline	Texas (35.5), California (28.0), Oklahoma (20.1), Louisiana (4.3).
Nickel	Not separable by States.
Oilstones, etc	Ohio,[1] Arkansas,[1] New Hampshire,[1] Indiana.[1]
Olivine	North Carolina (100.0).
Ores, crude:	
Copper	Utah (35.5), Arizona (31.6), Nevada (8.9), Michigan (8.3).
Dry and siliceous (gold and silver).	California (26.8), Alaska (24.4), Nevada (9.9), South Dakota (8.4).
Lead	Missouri (95.2), Idaho (2.3), Utah (1.4), Montana (0.4).
Lead-copper	Utah (61.9), Colorado (18.3), New Mexico (13.8), Nevada (2.7).
Zinc	Oklahoma (45.7), Kansas (25.6), Tennessee (14.1), New Jersey (8.0).
Zinc-copper	Arizona (100.0).
Zinc-lead	Oklahoma (46.3), Kansas (15.3), Idaho (10.4), Virginia (5.6).
Zinc-lead-copper	Utah.[1]
Peat	New York (33.0), New Jersey (21.2), Michigan (11.2), California (7.6).
Pebbles for grinding	California,[1] Minnesota.[1]
Petroleum	Texas (38.2), California (17.7), Oklahoma (12.6), Illinois (7.5).
Phosphate rock	Florida (71.3), Tennessee,[1] Idaho (2.5), Montana (1.2).
Platinum metals	Alaska (73.1), California (2.8), Oregon (0.05).
Potassium salts	New Mexico,[1] California,[1] Utah,[1] Maryland.[1]
Pumice	Kansas (46.7), California (40.6), Nebraska,[1] New Mexico.[1]
Pyrites	Tennessee,[1] Virginia,[1] New York (13.8), California.[1]
Salt	Michigan (26.0), New York (22.0), Ohio (19.3), Louisiana (11.6).
Sand and gravel	New York,[1] California (6.0), Washington (5.3), Michigan (4.8).
Sand-lime brick	New York,[1] New Jersey,[1] Michigan (14.1), Minnesota.[1]
Selenium	Not separable by States.
Silica (quartz)	Wisconsin,[1] California,[1] North Carolina,[1] Ohio.[1]
Silica sand and sandstone, ground.	Illinois (29.5), New Jersey (28.6), Ohio (11.9), Pennsylvania.[1]
Silver	Idaho (26.4), Utah (16.5), Montana (14.0), Colorado (13.0).
Slate [2]	Pennsylvania (45.7), Vermont (29.2), Virginia,[1] New York (7.0).
Sodium salts (other than NaCl natural).	California (79.9), Texas,[1] Wyoming,[1] Utah.[1]
Stone	Pennsylvania (10.7), Michigan (7.6), Ohio (7.6), New York (7.3).
Sulfur	Texas (79.9), Louisiana (20.0), California,[1] Utah.[1]
Sulfuric acid from copper and zinc smelters and roasters and from roasting of high-sulfide gold and silver concentrates.	Pennsylvania (32.7), Illinois (22.9), Tennessee,[1] Arizona.[1]
Sulfur ore	Nevada (54.4), Colorado (45.6).
Talc, pyrophyllite, and ground soapstone.[3]	New York (39.3), Vermont (15.5), North Carolina (14.5), California (13.3).
Tantalum ore	New Mexico,[1] South Dakota,[1] Wyoming.[1]
Tellurium	Not separable by States.
Tin	Alaska (97.4), South Dakota (1.6), Montana,[1] New Mexico.[1]
Titanium ore: Ilmenite	Virginia,[1] California.[1]
Titanium ore: Rutile	Virginia,[1] Arkansas.[1]
Tripoli	Missouri,[1] Illinois (33.3), Oklahoma,[1] Arkansas.[1]
Tungsten ore	Nevada (48.8), California (29.5), Colorado (11.2), Idaho (5.3).
Uranium and vanadium ores	Arizona,[1] Colorado (30.5), Utah (0.8).
Vermiculite	Montana,[1] Colorado,[1] North Carolina (6.6), Wyoming.[1]
Zinc	Oklahoma (28.6), New Jersey (18.1), Kansas (14.0), Idaho (9.7).

[1] Production figures not given separately.
[2] According to value.
[3] Exclusive of soapstone used as dimension stone (all in Virginia), which is therefore classified as "stone."

SOURCE: *Minerals Yearbook, Review of 1940.* Rank of States in metal production (except aluminum, ferro-alloys, and pig iron) arranged according to mine reporrs, not smelter output.

Table 5.—*Distribution of the value of minerals by States: All minerals combined and 4 principal minerals in order of value in each State, 1939*

State [1]	All minerals		First ranking mineral in State			Second ranking mineral in State			Third ranking mineral in State			Fourth ranking mineral in State		
	Rank of State	Percent of United States value	Name of mineral	Percent of United States value for designated mineral	Percent of State value of all minerals	Name of mineral	Percent of United States value for designated mineral	Percent of State value of all minerals	Name of mineral	Percent of United States value for designated mineral	Percent of State value of all mineral	Name of mineral	Percent of United States value for designated mineral	Percent of State value of all minerals
Alabama	20	1.23	Coal	3.0	53.2	Iron ore	6.3	19.1	Cement	3.6	12.8	Stone	1.6	4.8
Alaska	30	.61	Gold	12.1	92.3	Platinum metals	63.7	3.9	Coal	.1	2.3	Silver	.3	.5
Arizona	15	1.77	Copper	36.8	72.6	Gold	5.6	14.8	Silver	12.0	7.1	Lead	2.6	1.3
Arkansas	29	.70	Petroleum	1.3	56.9	Coal	.4	12.2	Bauxite	95.8	7.0	Natural gas	.4	6.8
California	3	11.04	do	17.7	49.0	Natural gas	17.1	19.6	Gold	25.6	10.7	Natural gasoline	39.4	7.6
Colorado	17	1.51	Molybdenum	(2)	(2)	Coal	1.6	22.7	do	6.5	20.0	Silver	13.0	9.0
Connecticut	44	.10	Stone	1.3	48.2	Clay products	1.0	29.2	Sand and gravel	.8	18.0	Lime	(2)	(2)
Delaware	50	.01	Clay products	.2	46.3	Stone	(2)	(2)	do	.1	15.3	Raw clay	(2)	(2)
District of Columbia	49	.01	do	(2)	(2)	do	(2)	(2)		(3)	(3)		(3)	(3)
Florida	35	.31	Phosphate rock	64.2	60.4	Cement	(2)	(2)	Stone	.9	11.2	Sand and gravel	.8	6.0
Georgia	34	.35	Stone	3.1	33.1	Raw clay	27.1	28.4	Clay products	1.9	16.2	Cement	(2)	(2)
Idaho	26	.78	Silver	26.4	35.3	Lead	21.6	25.8	Zinc	9.7	14.9	Gold	2.1	12.3
Illinois	6	4.97	Petroleum	7.8	48.1	Coal	8.3	36.2	Stone	4.9	3.7	Cement	3.8	3.4
Indiana	19	1.26	Coal	2.7	46.1	Cement	(2)	(2)	do	4.7	14.0	Clay products	4.6	10.5
Iowa	31	.60	Cement	4.2	30.5	Coal	.8	29.4	do	2.8	17.2	do	3.0	14.5
Kansas	8	2.91	Petroleum	4.9	51.1	Natural gas	5.5	23.8	Zinc	14.0	5.8	Cement	3.0	4.5
Kentucky	11	2.67	Coal	8.1	65.8	do	3.9	18.2	Petroleum	.5	5.2	Stone	2.8	4.0
Louisiana	7	3.99	Petroleum	7.6	58.0	do	10.1	31.9	Sulfur	(2)	(2)	Natural gasoline	3.7	2.0
Maine	45	.09	Stone	.8	32.6	Sand and gravel	.9	23.6	Cement	(2)	(2)	Clay products	.3	9.9
Maryland	37	.28	Coal	.3	25.3	do	2.8	23.9	do	(2)	(2)	do	1.4	14.4
Massachusetts	39	.19	Stone	2.8	54.5	do	1.7	21.0	Lime	3.3	12.3	do	.7	10.6
Michigan	10	2.74	Iron ore	23.4	31.9	Petroleum	1.6	18.4	Cement	5.9	9.4	Copper	6.2	7.9
Minnesota	12	2.51	do	61.3	91.2	Stone	1.5	2.2	Sand and gravel	1.9	1.8	Manganiferous ore	(2)	(2)
Mississippi	42	.12	Natural gas	.6	63.6	Sand and gravel	.8	15.6	Clay products	.6	14.7	Raw clay	(2)	(2)
Missouri	21	1.08	Lead	37.1	32.2	Cement	40.3	16.3	Coal	.7	13.4	Stone	2.9	10.1
Montana	18	1.50	Copper	13.7	32.1	Gold	4.7	14.6	Natural gas	1.2	10.2	Silver	14.0	9.7
Nebraska	43	.10	Cement	(2)	(2)	Sand and gravel	.9	20.0	Stone	.4	15.0	Clay products	.5	13.0
Nevada	25	.82	Copper	9.3	40.0	Gold	6.4	36.5	Silver	6.6	8.2	Tungsten ore	(2)	(2)
New Hampshire	47	.03	Stone	.3	36.8	Clay products	.3	27.1	Sand and gravel	.2	18.4	Feldspar	14.6	13.6
New Jersey	28	.71	Zinc	22.5	38.0	do	5.5	22.2	do	3.3	11.1	Stone	1.9	10.0
New Mexico	16	1.65	Petroleum	2.4	44.1	Copper	6.5	13.7	Natural gas	1.6	12.6	Potassium salts	(2)	(2)
New York	14	1.85	Natural gas	2.8	19.4	Petroleum	.8	13.6	Stone	6.4	12.9	Cement	5.4	12.6
North Carolina	33	.44	Stone	4.4	37.7	Clay products	3.8	24.8	Bromine	(2)	(2)	Sand and gravel	1.0	5.4
North Dakota	46	.06	Coal	.3	90.2	Sand and gravel	.1	4.8	Clay products	(2)	(2)	Natural gas	(4)	1.1
Ohio	9	2.83	do	3.5	26.9	Clay products	21.7	22.2	Natural gas	3.5	15.7	Stone	6.4	8.5
Oklahoma	5	5.58	Petroleum	12.8	70.4	Natural gas	5.3	11.9	Natural gasoline	17.2	6.6	Zinc	28.6	6.2
Oregon	38	.20	Gold	1.7	37.8	Stone	1.1	19.5	Cement	(2)	(2)	Sand and gravel	1.2	14.3
Pennsylvania	2	12.57	Coal	41.1	70.7	Petroleum	2.8	6.8	Natural gas	6.6	6.6	Cement	18.6	6.4
Rhode Island	48	.02	Stone	.4	57.0	Sand and gravel	.3	27.1	Clay products	(2)	(2)	Lime	(2)	(2)
South Carolina	41	.13	do	1.1	32.0	Clay products	1.3	29.0	Raw clay	8.5	24.0	Gold	.2	8.9
South Dakota	32	.59	Gold	11.0	87.3	Stone	.6	4.0	Cement	(2)	(2)	Sand and gravel	.7	2.9
Tennessee	23	.95	Coal	1.1	25.9	do	5.2	20.7	do	3.0	14.0	Phosphate rock	(2)	(2)
Texas	1	16.57	Petroleum	37.0	68.1	Natural gas	26.5	20.2	Sulfur	80.3	4.1	Natural gasoline	28.7	3.7
Utah	13	1.89	Copper	24.1	44.6	Gold	4.9	12.1	Silver	16.5	9.1	Coal	.8	8.9
Vermont	40	.16	Stone	2.2	48.9	Slate	29.2	27.9	Lime	1.5	6.5	Asbestos	(2)	(2)
Virginia	22	1.03	Coal	2.7	56.5	Stone	3.7	13.5	Clay products	2.3	6.5	Cement	(2)	(2)
Washington	27	.75	Cement	(2)	(2)	Sand and gravel	5.9	10.1	Coal	.6	16.6	Gold	1.6	10.0
West Virginia	4	6.51	Coal	20.8	68.9	Natural gas	11.8	22.9	Petroleum	.5	2.2	Stone	2.8	1.6
Wisconsin	36	.30	Stone	2.2	28.1	Iron ore	2.2	27.8	Sand and gravel	2.6	20.6	Cement	(2)	(2)
Wyoming	24	.93	Petroleum	1.4	46.0	Coal	1.2	27.3	Natural gas	.9	12.4	Natural gasoline	1.7	4.0

[1] Includes Alaska and District of Columbia. [2] Value not given separately. [3] Data not available. [4] Less than 0.05 percent.

Source: *Minerals Yearbook, Review of 1940.*

were when vast resources of land in the western sections of the country were undeveloped. Virtually complete occupation of land from coast to coast, smaller differences in intensity of demands on resources among geographic divisions, and maturation of the economy in other respects, dictate a more selective, although not necessarily an optimum, use of resources. The relocation will result partly from decisions in enterprise based on judgments formed from available information on factors affecting location and partly from governmental policy toward land use, pricing, tariffs, commerce, conservation, and the like. Investigation of the bearing of resources on location may be expected to aid both enterprise and government in making desirable adjustments.

American industry consumes a multiplicity of minerals obtained from widespread locations (see tables 4 and 5 and figs. 6–19). The Bureau of Mines reports data on 91 varieties that are used and some minerals are not covered. It would seem that the complexity of mineral resources is too great to enable the drawing of conclusions on locational effects. This would be true if all or most of them exerted a strong pull on industry. Actually the geographic drawing power of most of the minerals is relatively minor owing to the small quantities used, high unit values, and necessity of using the minerals in combination with other materials.

Chief Mineral Resources

Eight mineral materials—petroleum, coal, natural gas, cement, iron ore, stone, sand and gravel, and cop-

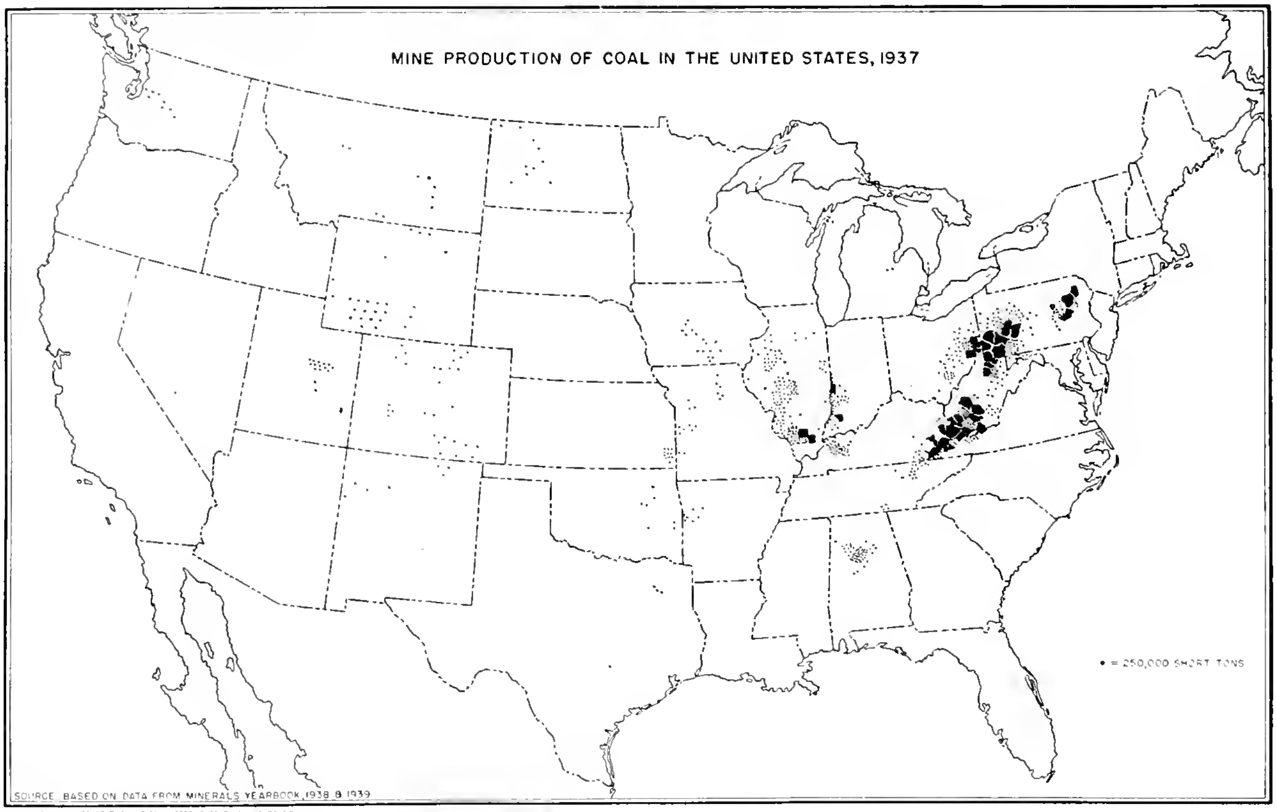


FIGURE 7

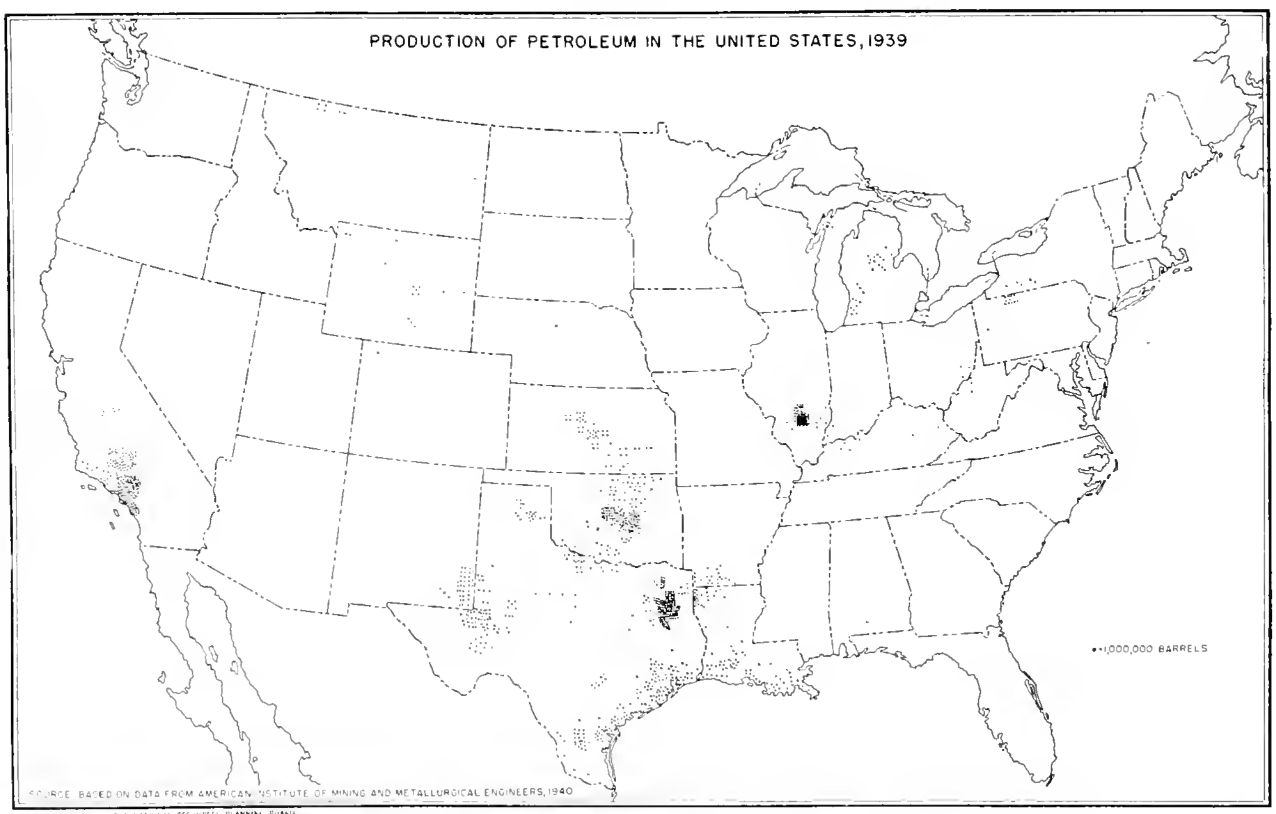


FIGURE 8

per—accounted for 84 percent of the value of all mineral materials produced in 1939 and for 93 percent of the total weight (cf. figs. 20 and 21). Of these eight, coal and iron ore have had the greatest locational influence for reasons that will become apparent when further facts are considered. Probably the existence of an abundance of cheap coal and iron ore in the Western Mountain States would have been sufficient to alter markedly the distribution of industry in the Nation despite the limitations of agricultural resources in those States.

Certain of the mineral resources have such general application that they stand apart from those of special use in the determination of location. Mineral resources of general use are the fuels, iron ore, copper, lead, zinc, aluminum, limestone, and salt.

Mineral fuels have the most general applicability of all resources, for there is hardly a phase of economic activity they do not affect. Application of inanimate energy is the key to high productivity in nearly all branches of industry. In addition to the mineral fuels, water power and wood fuel are sources of energy, but relatively minor ones. Of the annual energy supply from ground sources, coal contributes 51 percent, petroleum 34 percent, natural gas 11 percent, and water power about 4 percent; wood fuel contributes probably less than water power in relation to these sources.

In terms of value at or near the source of supply (cf. table 6), mineral fuels are slightly more than four times as important as all metallic ores produced, including iron ore, copper, gold, silver, lead, zinc, and aluminum.[1] They are about four and one-half times as important in terms of weight. The value of mineral fuels is four and one-half times that of other nonmetallic minerals and their weight is one and three-fourths times as great.

Among the eight chief minerals that account for 93 percent of the weight of all minerals, petroleum, cement, stone, sand and gravel, and copper are either widely available or are not particularly prevalent in the northeastern belt, which has 72 percent of the total manufacturing of the country. These five minerals, therefore, could not by themselves explain the marked concentration of manufacturing. Likewise the resources that provide the remaining 7 percent of the weight of minerals could hardly have a controlling influence. This is not to deny that minor minerals individually may have a strong influence on the location of segments of industry. Indeed, a limited amount of processing nearly always takes place at or near the point of production, but the volume of employment provided is, as a rule, small in comparison to that in succeeding stages of processing or manufacture.

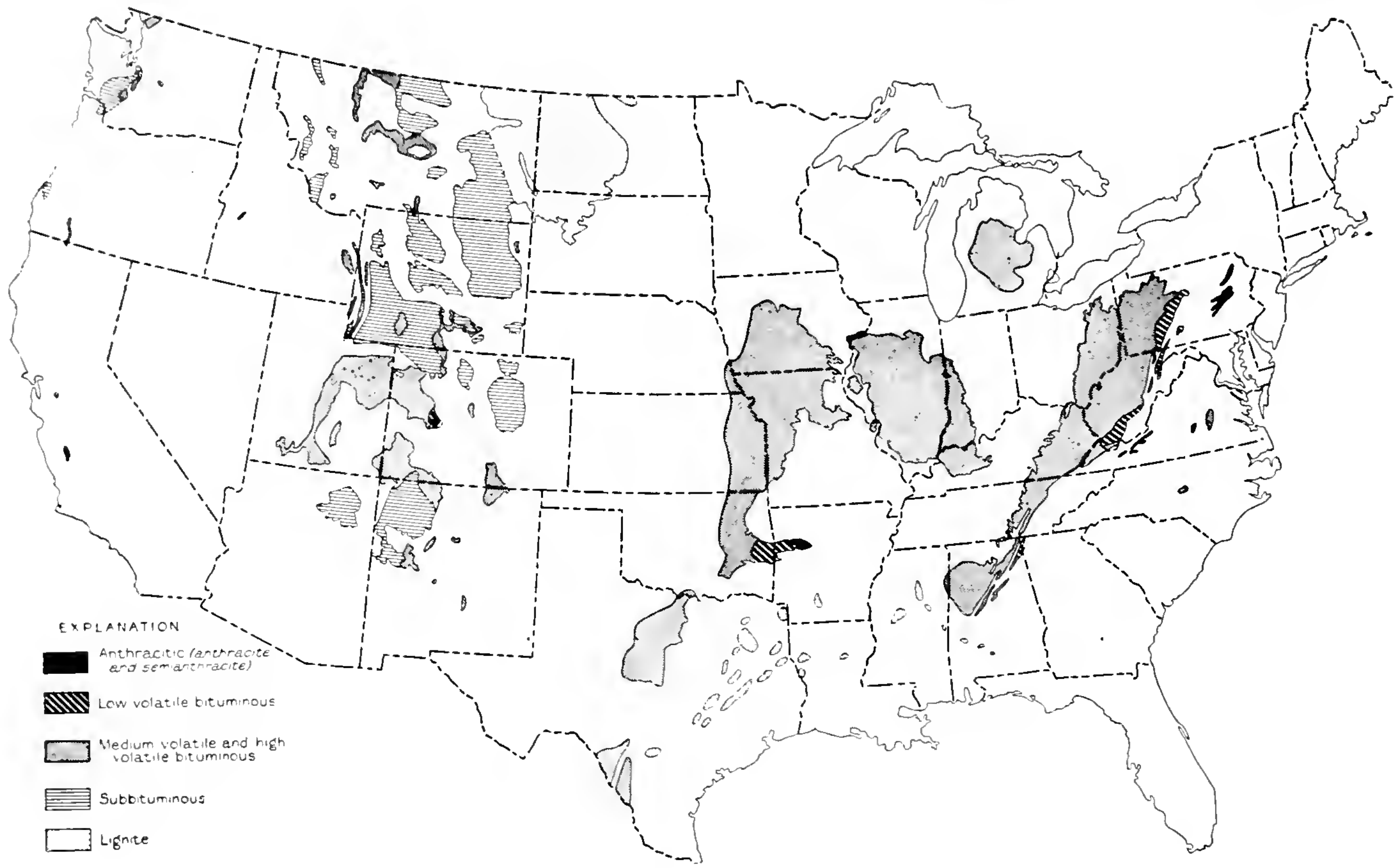
TABLE 6.—*Value of minerals produced by States and proportion for coal, petroleum and natural gas, and for nonfuel minerals, 1939*

State	Value of all minerals (000 dollars)	Percent of State total value		
		Coal	Petroleum and natural gas	Nonfuel minerals
Alabama	52, 124	54	0	46
Arizona	75, 057	(1)	0	[2] 100
Arkansas	29, 507	13	67	20
California	467, 612	0	76	24
Colorado	64, 072	23	3	74
Connecticut	4, 306	0	0	100
Delaware	401	0	0	100
District of Columbia	592	0	0	100
Florida	13, 060	0	0	100
Georgia	14, 633	(1)	0	[2] 100
Idaho	33, 139	(1)	0	[2] 100
Illinois	210, 296	36	49	15
Indiana	53, 423	47	4	49
Iowa	25, 484	29	0	71
Kansas	123, 392	4	76	20
Kentucky	113, 243	65	24	11
Louisiana	168, 903	0	92	8
Maine	3, 770	0	0	100
Maryland	11, 838	25	0	75
Massachusetts	8, 180	0	0	100
Michigan	115, 970	1	25	74
Minnesota	106, 428	0	0	100
Mississippi	5, 192	0	65	35
Missouri	45, 619	13	1	86
Montana	63, 355	6	19	75
Nebraska	4, 390	0	(3)	100
Nevada	34, 671	0	0	100
New Hampshire	1, 187	0	0	100
New Jersey	30, 271	0	0	100
New Mexico	69, 922	5	59	36
New York	78, 384	0	34	66
North Carolina	18, 534	0	0	100
North Dakota	2, 690	90	1	9
Ohio	119, 751	27	19	54
Oklahoma	236, 177	1	89	10
Oregon	8, 636	(1)	0	[2] 100
Pennsylvania	532, 356	71	13	16
Rhode Island	981	0	0	100
South Carolina	5, 423	0	0	100
South Dakota	24, 811	(3)	(3)	100
Tennessee	40, 120	26	(3)	74
Texas	701, 940	(3)	92	8
Utah	80, 222	9	1	90
Vermont	6, 972	0	0	100
Virginia	43, 583	57	(3)	43
Washington	31, 590	17	(3)	83
West Virginia	275, 563	69	26	5
Wisconsin	12, 705	0	0	100
Wyoming	39, 425	27	62	11
Total value	4, 209, 900	22	45	33

[1] Value not given separately. Production is negligible.
[2] Includes value of coal, not given separately.
[3] Less than 0.5 percent.
SOURCE: *Minerals Yearbook, Review of 1940.*

Among the metallic ores, four types require special analysis because of their volume. In 1939 iron ore accounted for 34 percent of the total for metallic ores, copper ores for 38 percent, lead-zinc ores (all types) for 15 percent, and gold-silver ores for 12 percent. All other metallic ores, including such important ones as bauxite, manganese, molybdenum, tungsten, and vanadium, constituted scarcely more than 1 percent of the total. These percentages are a clue to the bulk of material that has to be moved at the mine. There are, of course, great differences in accessibility that would necessitate variable effort for a given quantity of extraction. The chief cost difference would be between open-pit and underground operations. Open-pit mining of such minerals as iron ore and copper ore can yield huge volumes at minimum outlays per ton.

[1] In these calculations adjustments have been made in the Bureau of Mines data to make them apply as nearly as possible to the source of supply. For example, iron ore is substituted for pig iron.



U. S. Geological Survey, Department of Interior

Figure 9.—Coal fields of the United States

Subject to these qualifications, the data on proportions of ores extracted roughly indicate the magnitude of industry directly concerned in mining operations.

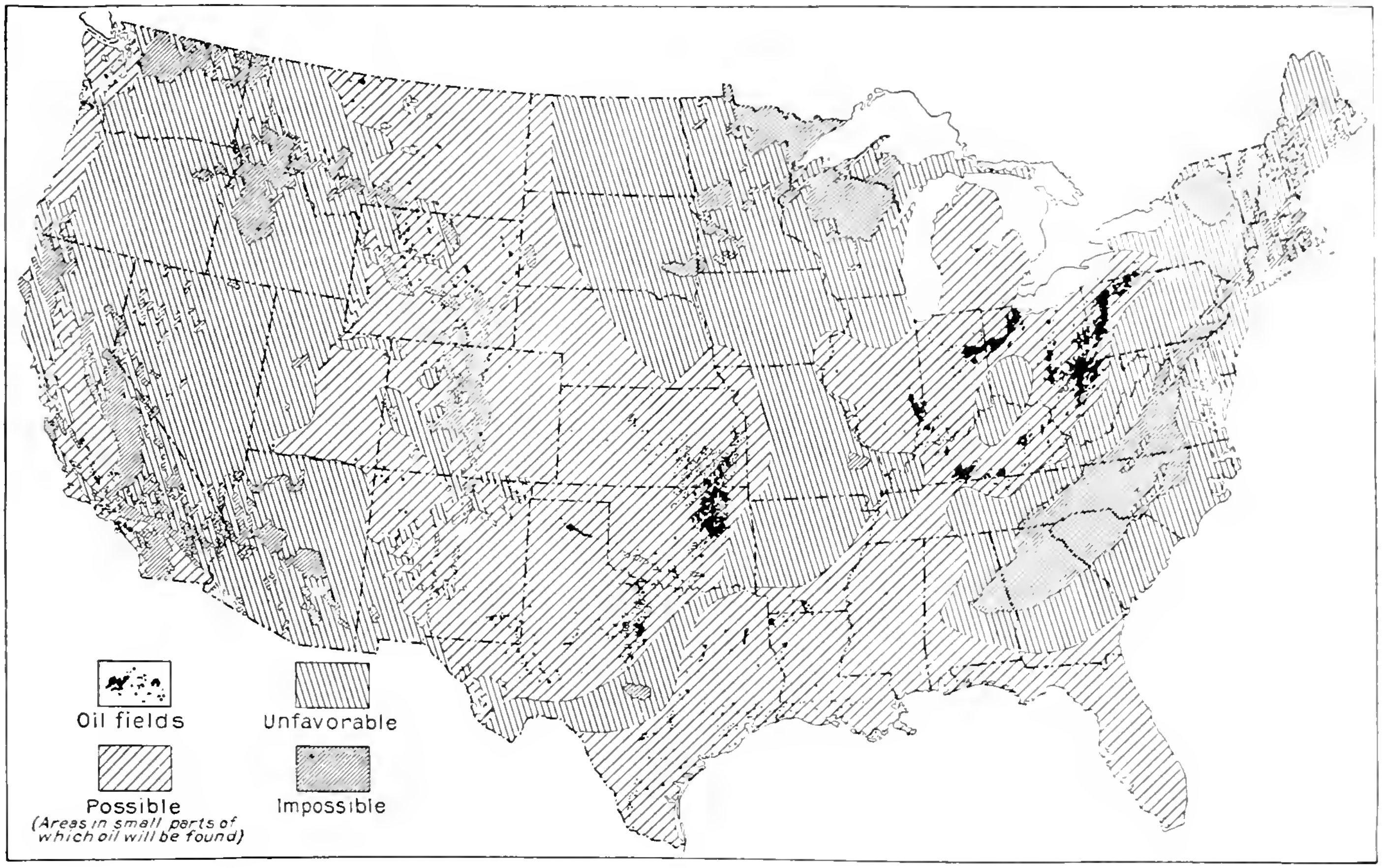
Much of the influence of mineral resources on location of industry depends on the extent to which the bulk of the ore is reduced at the mine. As a rule, nonmetallic minerals are shipped from production areas without substantial reduction. The major items—coal, petroleum, stone, sand, gravel, and cement—undergo little weight loss from the source to the point of final use. Complete weight loss by fuels during use precludes effects on location from salvage of scrap materials, or from use over an extended period, whereas stone, sand, gravel, and cement may be converted from one form to another and may be used over long periods.

Durability and repeated use decrease the locational pull of materials because the amortization charge is reduced relative to that on goods requiring comparable outlays but having a short life. Steel for construction of a flour mill may be shipped great distances in response to the locational pull of a small favorable cost differential on flour production involving a rapid turnover of product. The cost factor in materials should be considered with regard to use during a given period of time rather than to initial outlays for the materials.

The major nonmetallic mineral resources, except fuels, are present in almost all States in sufficient abundance to meet most local needs, giving no region a clear locational advantage.

Mineral Fuels

When, however, mineral fuels are considered, a markedly different conclusion is reached. The great bulkiness of these materials has already been observed. More than two-fifths of the originating railroad freight tonnage, including manufactured and semimanufactured commodities, consists of coal, coke, crude petroleum, and petroleum products. Since fuels disappear entirely, or almost entirely, during use, immediate replacement becomes necessary for continued operation, and this replacement seldom takes place from stocks on hand over long periods of time. Consequently the consuming industry must keep in close touch either directly or through middlemen with the source of supply. Certainty of supply is often important, particularly if output is of the continuous process type, as in the production of pig iron or manufactured gas.



U. S. Geological Survey

FIGURE 10.—Classification of areas according to relative likelihood of producing commercial quantities of oil

Mineral fuel resources usually are more localized geographically than are the other leading nonmetallic mineral resources, although they are far from being as limited in area as, for example, high-grade iron ore reserves. Texas alone has 56 percent of the proved petroleum reserves of the Nation, California has 17 percent, Louisiana 6 percent, and Oklahoma 5 percent. Thus these 4 States, 3 of which are contiguous, have 84 percent of the total reserves. It might appear that petroleum resources would exert a strong influence on location, but all these States are outside the area of manufacturing concentration in the Northeast.

Several factors help to explain this wide gap between location of petroleum resources and industry. Probably first in order of importance is the newness of petroleum as an industrial fuel. The transition from the kerosene-lamp stage to the automotive stage has occupied hardly more than 35 years. The first large-scale use of gasoline was in passenger automobiles. The great expansion in consumption of petroleum products for trucks and tractors has come since World War I, and that for steam production and for stationary Diesel engines since about the middle 1920's. This development has been too recent to have a profound influence on the location of industry although a strengthening of the influence may be expected in the future unless depletion of reserves in existing areas and shifts to other sources in the United States or abroad begin before long. The attraction of industry to the areas of large petroleum reserves has been retarded no doubt because initial areas of petroleum production were in western Pennsylvania, the first well having been completed in 1859, near the heart of the manufacturing belt, where supplies helped to reinforce the existing concentrations in location. At the outset transportation costs were inordinately high; the liquid was hauled at great expense by teamsters to points of consumption, or to rail or water transportation. As a result outlying areas were at a disadvantage. Petroleum and its products are now transported by pipe line or tanker at costs far below even those of the railroad haul. Regional differences in oil prices are now comparatively small. Gasoline and fuel oil may be transported 2,000 miles by pipe line and 3,000 by tanker with an increase in price of less than one-third. Such an in-

crease is likely to represent such an insignificant proportion of the final value of the product that it may easily be outweighed by other factors.

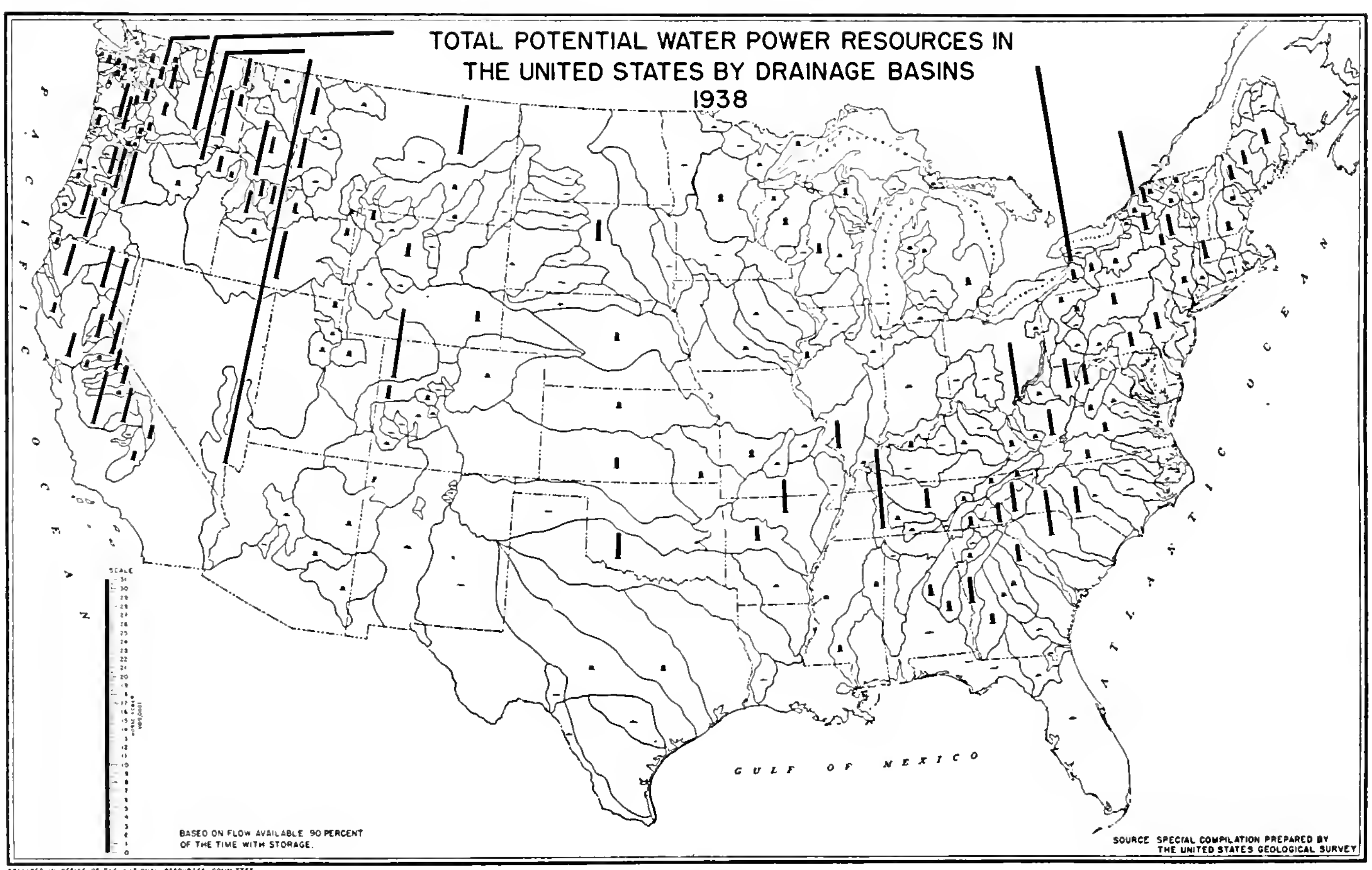
Coal exhibits in marked degree the characteristics that influence the location of industry. It is still the most important fuel used in manufacturing, being more than four and one-half times as large, on a heat-value basis, as oil and about four times as large as natural gas.[2] In 1939, 44 percent of the coal taken by manufacturing industries was made into coke, 67 percent of which was used in iron and steel manufacture. The coke and the iron and steel industries consumed over one-half the coal taken by all manufacturing industries.

Whereas oil and natural gas are used extensively for residential purposes and by transportation industries, bituminous coal is used to a large extent by industries that more directly determine or influence the location of economic activities. Anthracite, however, is mainly a residential and small commercial-industry fuel, and consequently the anthracite resources would be expected to have a limited locational effect. A probable reflection of the relative locational significance of coal and oil resources is the fact that in 1939 the dominant manufacturing section north of the Potomac and Ohio Rivers and east of the Mississippi River, which includes or is close to coal-mining areas, consumed 77 percent of the coal (anthracitic and bituminous) taken by manufacturing industries and 67 percent of the fuel oil used in those industries despite the location of the major oil fields far outside of the section. Fuel oil was transported great distances into the area for use in manufacturing, much more than coal was transported out for factory use in other areas.

In terms of tonnage coal is more important than any other material used in industry. Transportation rapidly increases its cost; a railroad haul of less than 300 miles may increase the price to double that at the mine. Although water transportation of coal is markedly cheaper than railroad transportation, most of the coal production is not on navigable waterways, and therefore coal requires haulage by railroad or truck except for the small portion used at the mine. The large expense of haulage is an incentive to locate close to the mine and especially so for basic metals that consume large amounts of coal for smelting.

The locational pull of coal would be weak if coal resources were more evenly distributed. Indeed, 31 States have appreciable resources of coal and the

[2] Based on Bureau of Census, *Census of Manufactures: 1939*, preliminary report on fuel, processed release issued May 5, 1941; and on Bureau of Mines, *International Coal Trade*, May 31, 1941, p. 16.



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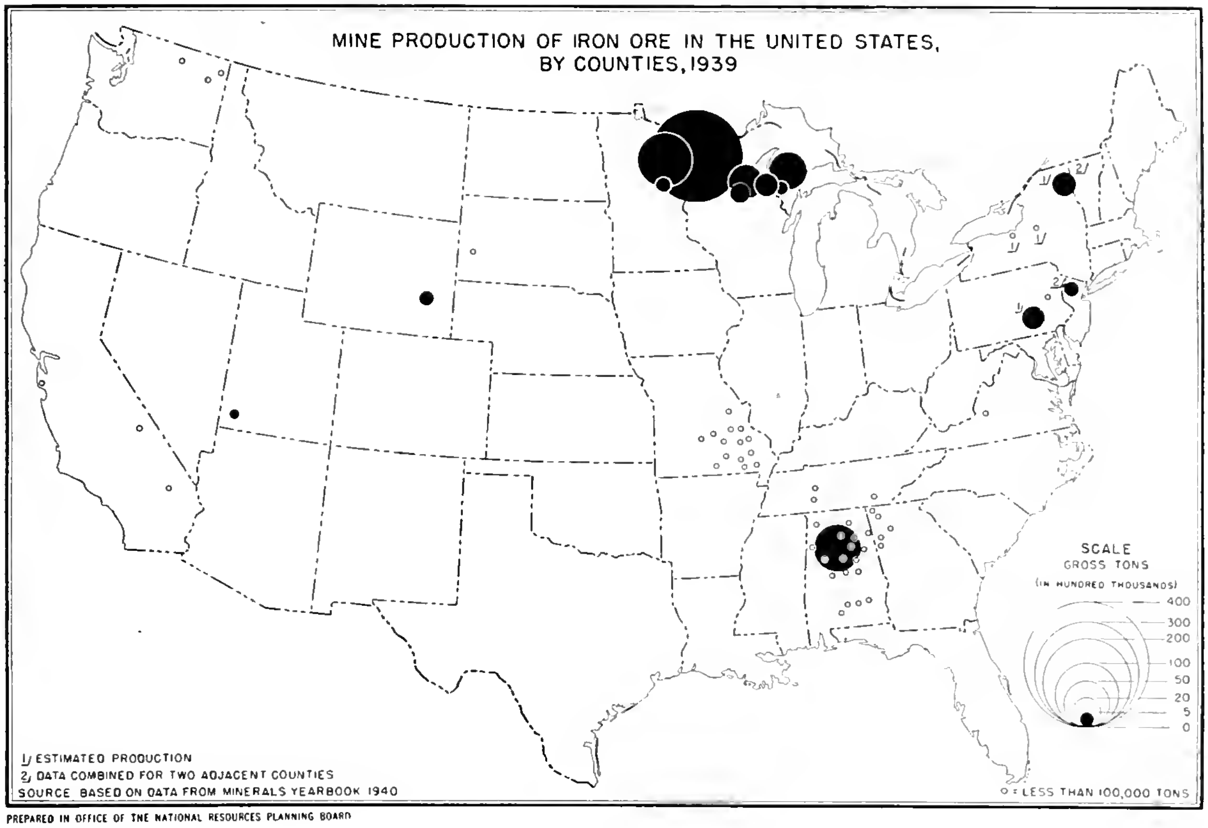

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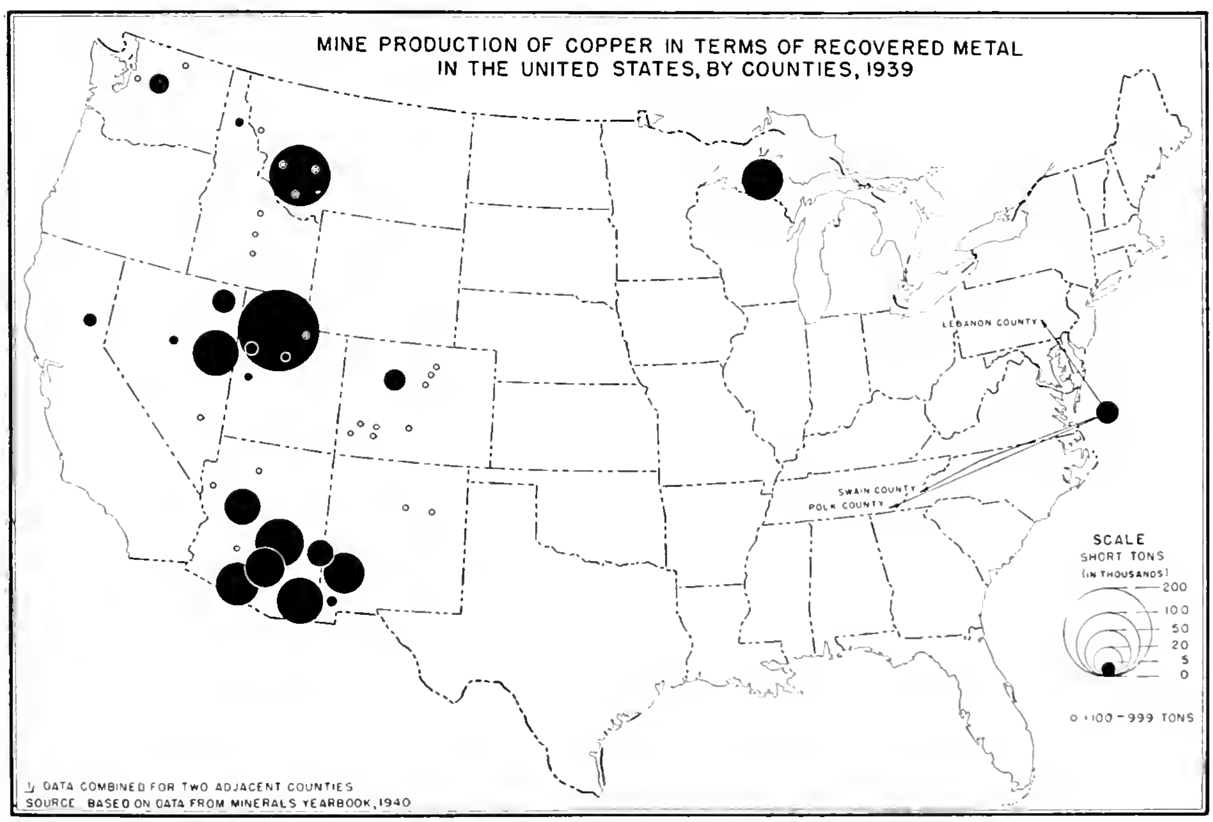

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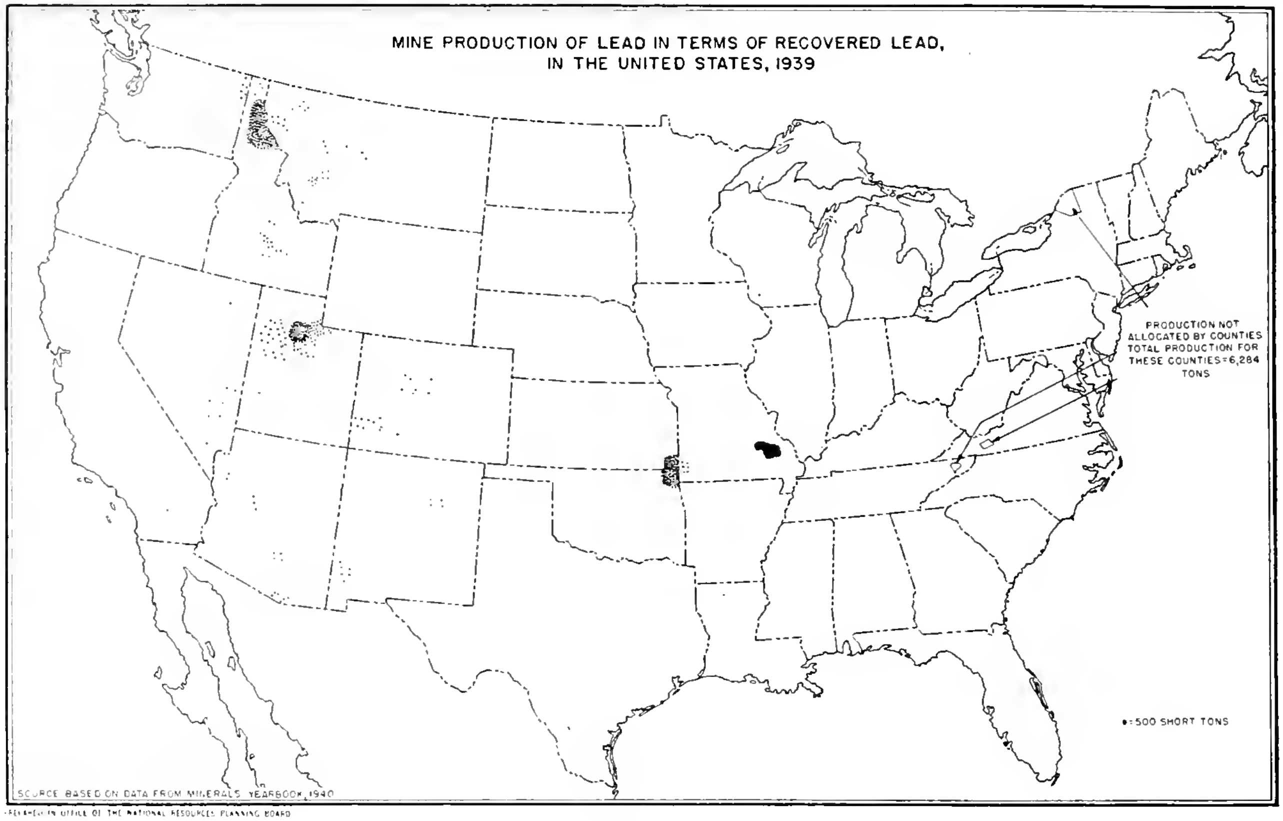

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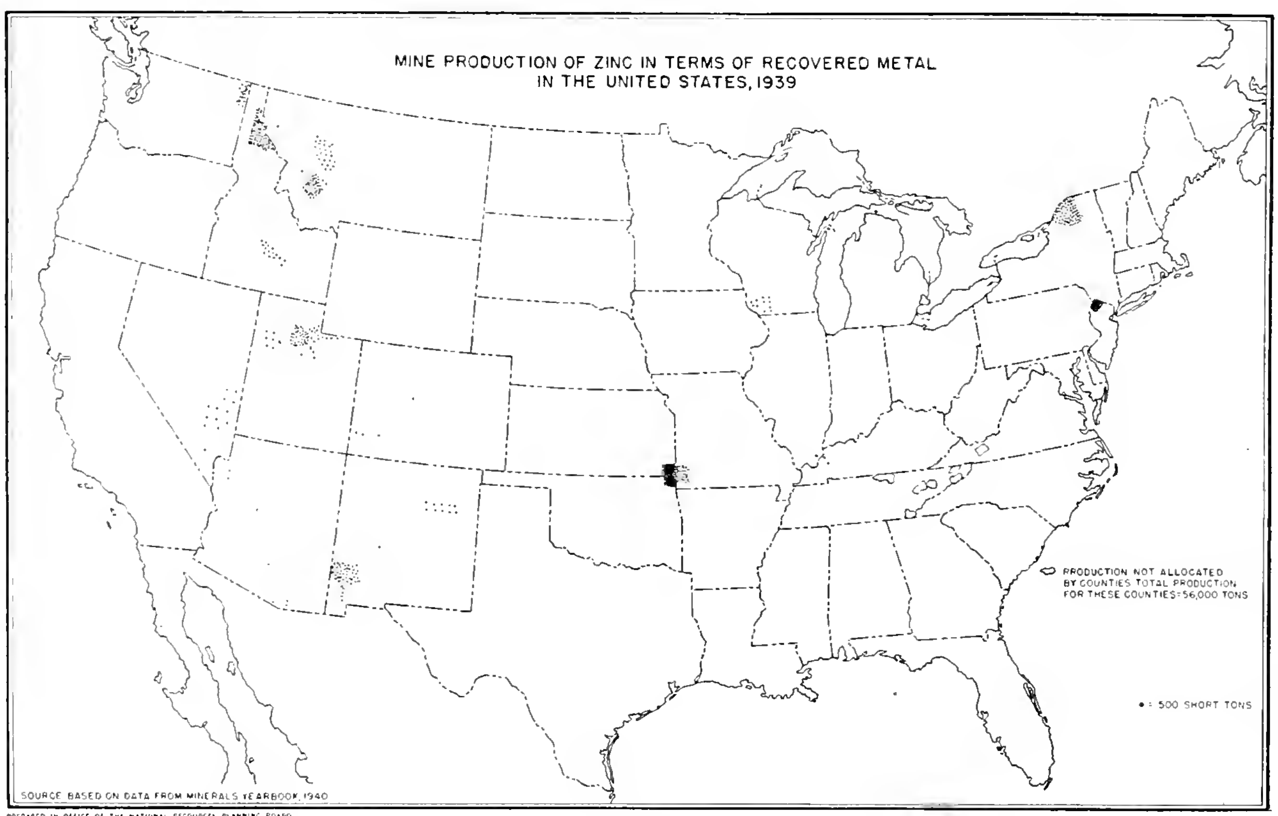

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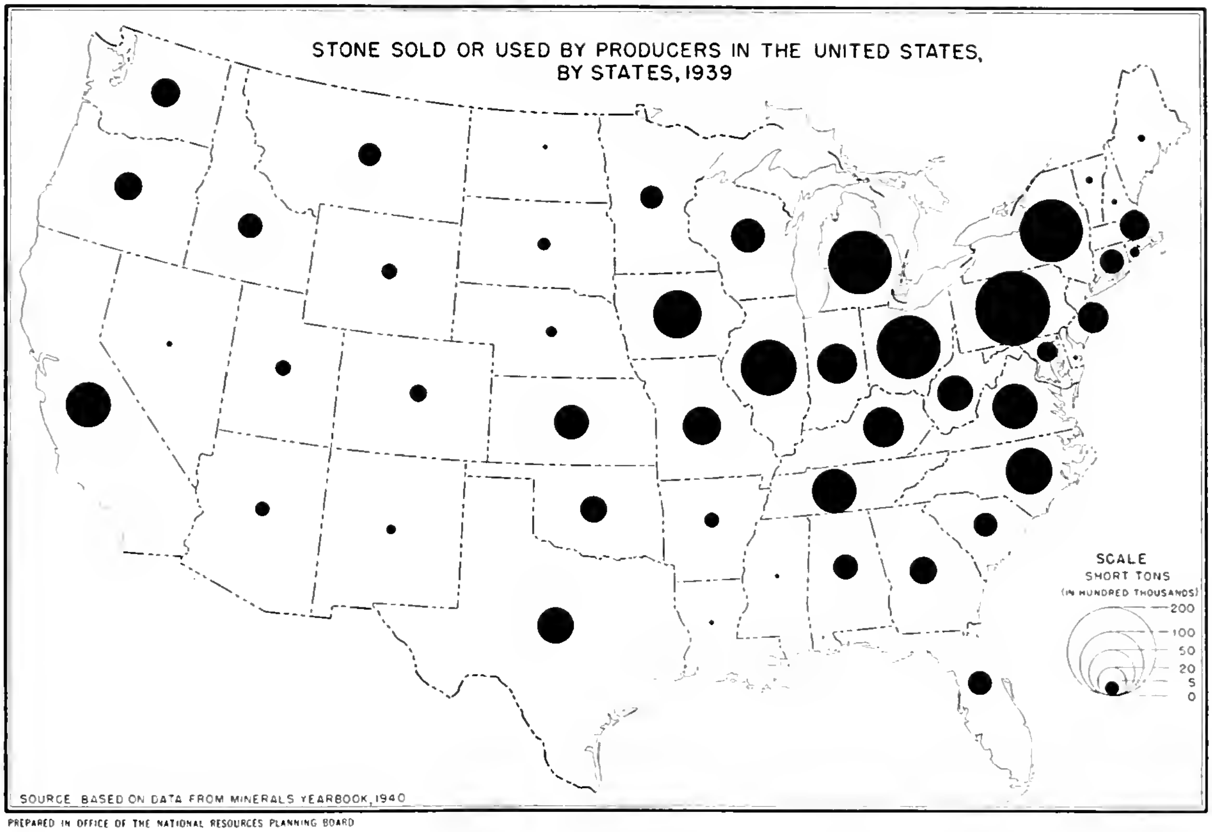

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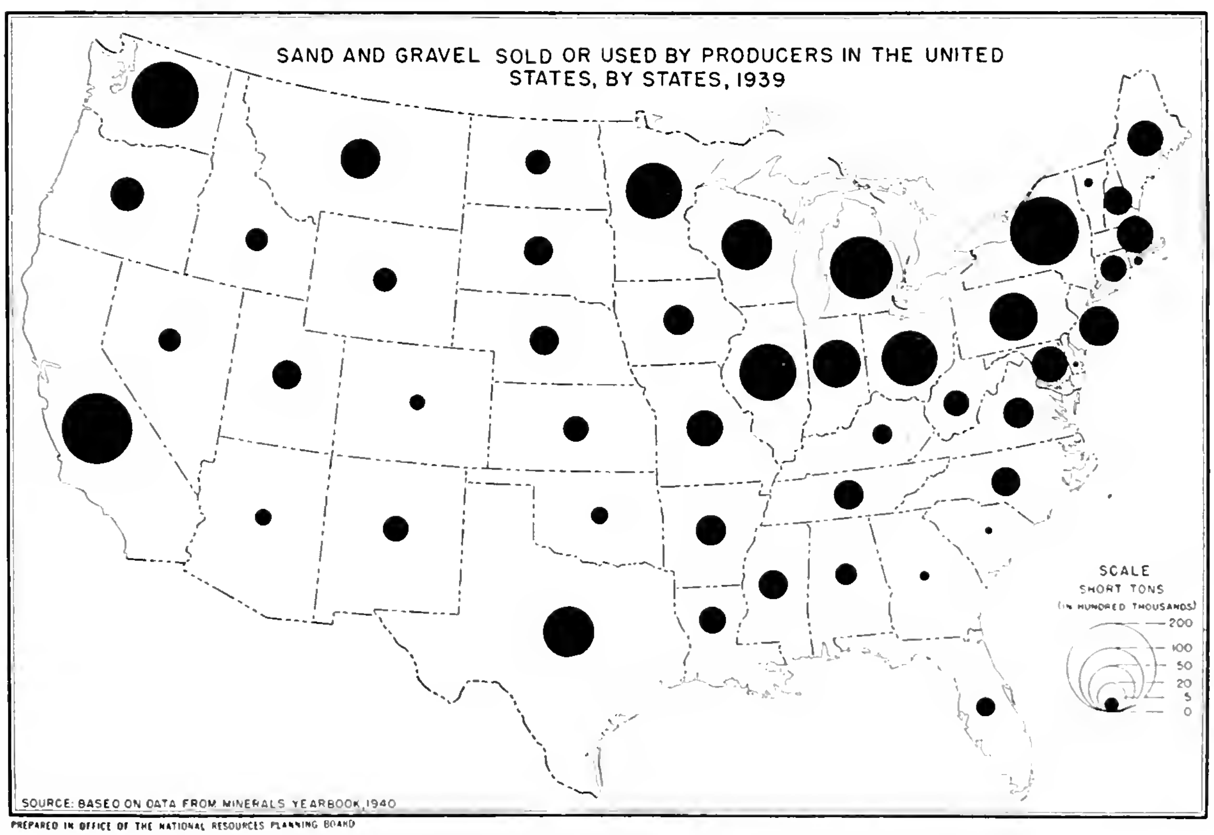

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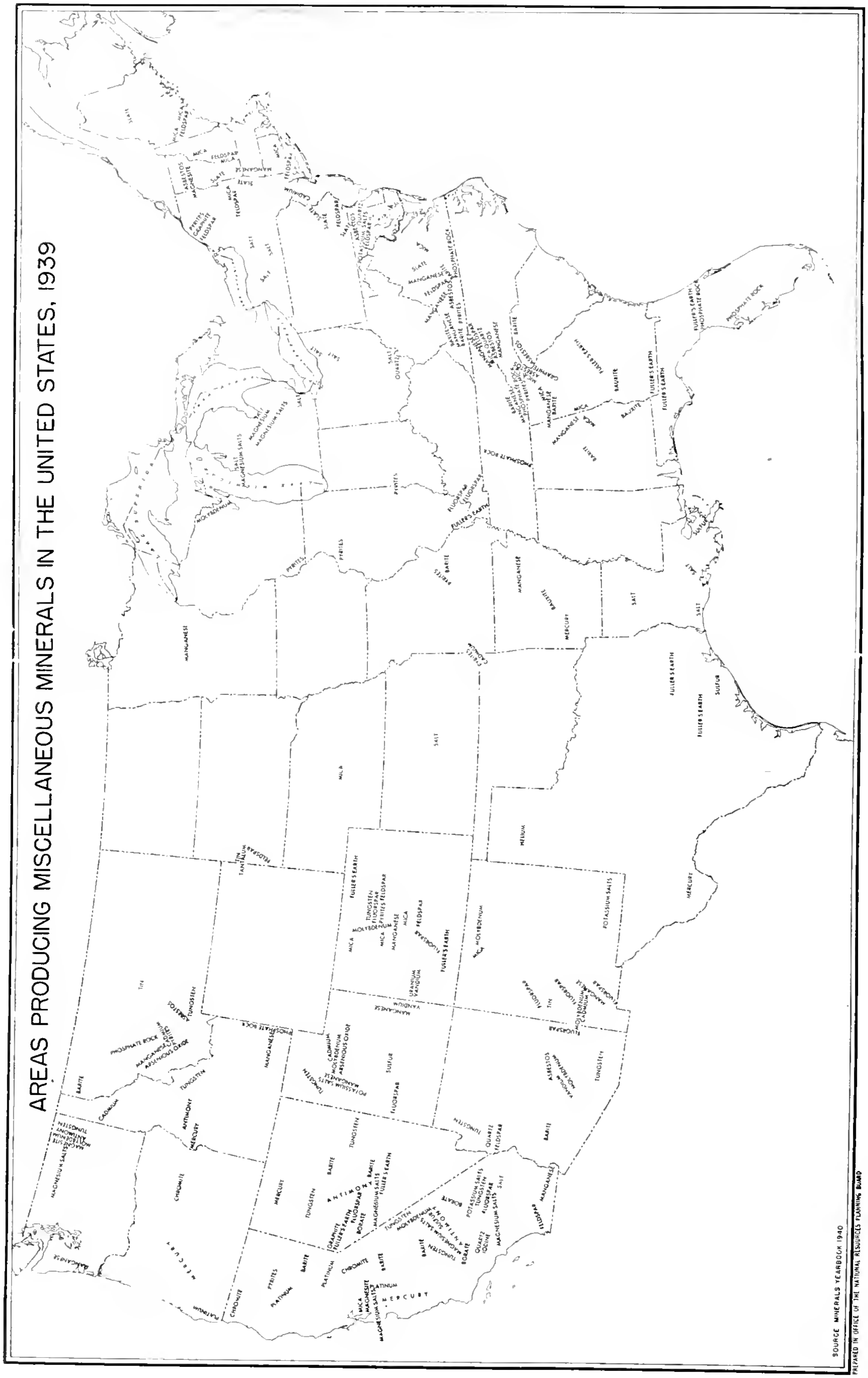
AREAS PRODUCING MISCELLANEOUS MINERALS IN THE UNITED STATES, 1939
SOURCE MINERALS YEARBOOK 1940
PREPARED IN OFFICE OF THE NATIONAL RESOURCES PLANNING BOARD

FIGURE 18

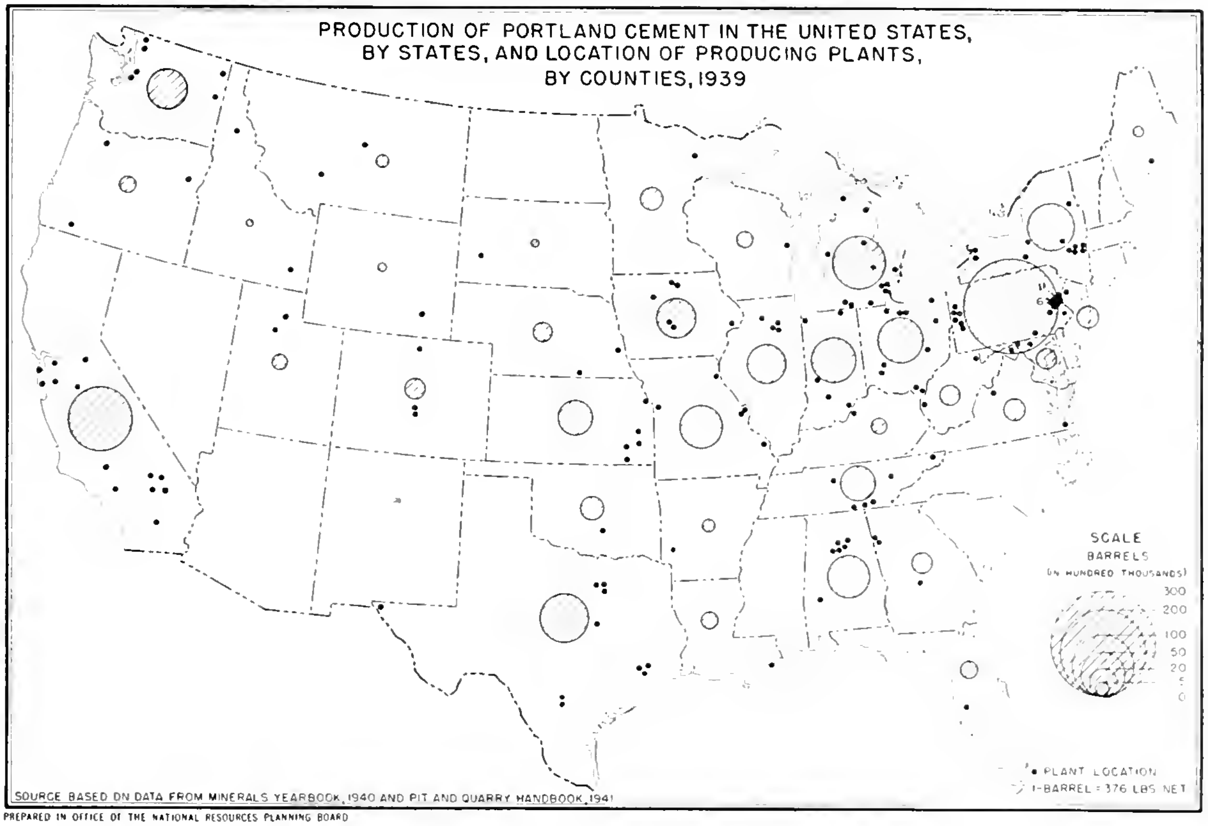

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FIGURE 19

general impression given by a map of coal resources is that they are widely scattered and that accordingly there is no need to concentrate coal mining in certain areas. This conclusion, however, overlooks the exceptional variability in quality and occurrence of coal beds. The coal beds vary in thickness, pitch, and purity. Reported measurements of coal resources assume only minimum standards that are far below the practical standards for mining at the present time. The heat value of coal varies from less than 6,000 British thermal units per pound to more than 14,000. In addition there are other properties such as brittleness, tendency to caking, ash and sulphur content. The quantity of coal suitable for metallurgical industries is really very limited, and the Appalachian coal region has the good fortune of containing by far the richest deposits of this basic resource. This fact helps to explain why this region has 70 percent of the coal production in good years, even though it has less than 20 percent of the estimated coal reserves measured in terms of tonnage and disregarding rank.

Industries that do not require special qualities in coal, of course, are free to locate over a wider area, insofar as nearness of coal is a factor. It would indeed be an exaggeration to say that existing geographic patterns of coal use are inevitable. Areas of production may be shifted in response to numerous factors in the coal industry, in transportation, or in consuming industries. Coal resources unlike oil resources are well known, and, therefore, spectacular shifts based on exploration are not probable, but technological changes, such as improved methods for mining thin beds or for production of cokes, may lead to mining of supplies in new locations. Moreover, recognition must be given to the fact that locational factors not connected with coal may result in drawing of coal supplies from one portion of the reserves rather than from another. In other words, somewhat wide availability of coal may permit a concentration of industry in one region that would not be possible if coal were not available locally. Thus coal resources exhibit in numerous instances a rather neutral effect on location because of the broad geographic distribution found so commonly among other nonmetallic minerals. On the whole, nevertheless, the locational influence appears to be considerable for the reasons cited earlier.

Metallics

When metallic minerals are compared with nonmetallic minerals certain typical differences appear. Some of the important ones from the standpoint of location are: (1) greater reduction of bulk of the former during the early stages of processing, (2) larger number of stages of handling, and (3) larger spread in the value of the final product from the

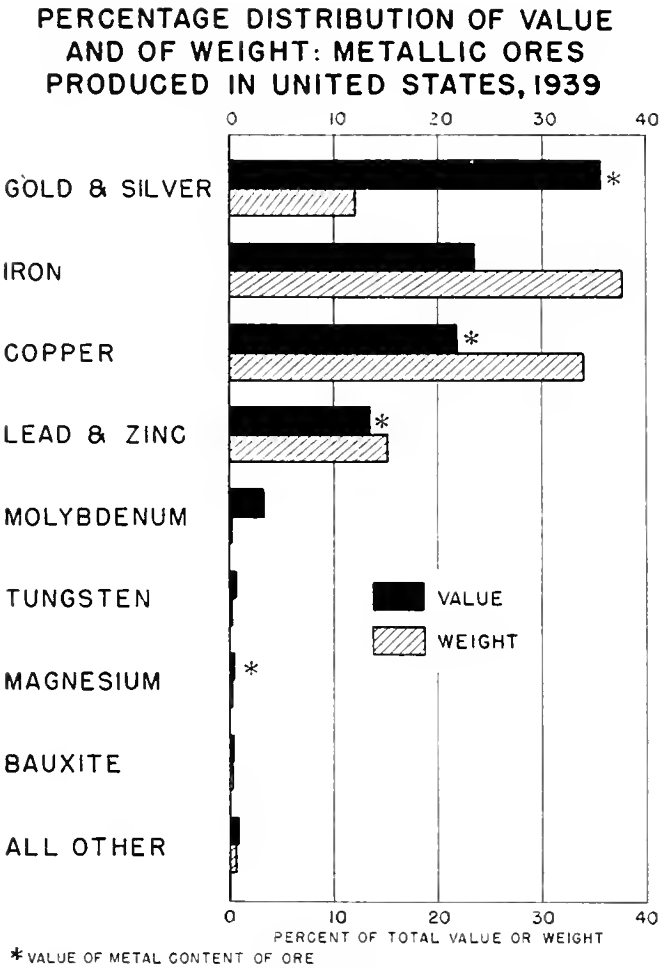


FIGURE 20

value of the mineral when it is first extracted. Copper, aluminum, and iron resources, for example, may undergo an almost infinite multiplication of value during the course of utilization, whereas petroleum, stone, coal, natural gas, and other nonmetals are subject to a limited amount of manufacture and other handling.

The reduction of bulk of metallic minerals is especially noteworthy in this discussion of the influence of resources. Reductions of bulk owing to cutting off of waste ends to get desired shapes and sizes is a factor in the later stages of utilization. More directly connected with use of resources is the reduction in the earlier stages of metal from the ore. A survey of this factor discloses two facts of outstanding significance to location of industry. One is the large reduction of weight of major metallic minerals, except iron ore. The other is location of all or most of the reduction at or near the area of mining, iron ore again being the glaring exception. In 1939 almost as much copper ore was mined as iron ore, about one-third as much gold and silver ore, and about two-fifths as much lead and zinc ore. But note that the copper ore yielded less than 2 percent copper metal, gold and silver ore a small fraction of 1 percent metal, and lead and zinc ore less than 4 percent metal, whereas the average yield of the iron ore was 50 percent...

A comparison in terms of refined metal, however, disregards the additional influence that the location of refining may have on the quantity of material to be transported to the point of use. Iron ore is transported in crude or nearly crude form all the way from the iron mines to iron and steel plants that account for a substantial part of manufacturing employment. The dominant movement is from the Lake Superior district to iron and steel centers in Illinois, Indiana, Michigan, Ohio, Pennsylvania, and New York, all in the manufacturing belt. Other leading domestic metallic minerals (bauxite might be considered an exception) are refined or partially refined near the source of supply, so that the bulk requiring shipment is markedly reduced. This centering of refining of nonferrous metals at the source of supply has a twofold effect on the location of industry. In the first place it attracts some industry besides mining. Centers in Montana, Utah, Nevada, and Arizona are commonly supported by this type of activity. These States, however, do not have large populations nor large manufacturing industries because of the second effect of this refining on location. The reduction of bulk at scattered sources of supply facilitates location of further uses of the material in other areas where product combinations, markets, labor supply, or other locational factors offer attractions. Refining of ores at the source, usually by simple processes that do not employ much labor or add greatly to local income, actually increases the freedom of location for the later stages of production that may become a prolific source of employment and income for the economic support of an area. As a result, the locational pull of the nonferrous metals is likely to be comparatively weak.

Among the metals the transported bulk of materials consists overwhelmingly of iron ore. Considering that iron ore is hauled long distances in crude form, whereas other metals are refined near the source, the tons of material transported away from iron mines is at least 20 times that from all other metallic-mineral mines combined. The gravitation of large segments of industrial activity to the junction point of iron ore and coal is, therefore, quite in line with a balancing of locational forces. Undoubtedly the iron-ore resources in the Lake Superior district, the coking-coal resources in the Appalachian coal region, and the Great Lakes waterway acting as a low-cost transportation connecting link have been the dominant elements among resources affecting the location of the steel industry and of other industries as well.

An explanation of location in terms of dominance, of course, omits much of the problem. Analysis of

location of specific industries involves numerous factors other than resources and therefore will not be considered in this chapter, which is concerned with the geographic distribution of resources and evaluation of resources as one type of locational influence.

Raw Material Transportation Costs

Considerable stress has been placed on the relative weight of materials as a guide to the bulk to be handled in extraction, storage, and shipment to markets. Such an approach would be open to serious question if raw materials were compared with semifinished or finished articles that involve special problems of handling. But crude materials for industry, with a few exceptions, can be handled by simple, large-scale methods and, accordingly, comparisons in terms of weight are reasonably valid.

Data made available for 1932 in the report of the Federal Coordinator of Transportation indicate the approximate range of variation of railroad freight outlays for basic materials. Despite variations in length of haul and load per car, the freight per ton-mile for any of the chief raw materials or raw-materials classes is not as much as three times as large as that of another, at table 7 indicates. The widest spread is from 0.61 cent per ton-mile for lead and zinc ingots, pigs, and bars, which have an average haul of 953 miles, to 1.80 cents per ton-mile for baled cotton, which has an average haul of 411 miles. Most of the other rates are within a much smaller range. This small spread in rates is in sharp contrast to marked differences in the bulk of raw materials used in industry.

TABLE 7.—*Railroad freight revenue, length of haul, and load per car, United States averages by commodities for traffic originated, 1932*

	Freight revenue per car	Average haul	Freight revenue per car-mile	Average load per car	Freight revenue per ton	Freight revenue per ton-mile
	Dollars	*Miles*	*Dollars*	*Tons*	*Dollars*	*Cents*
All commodities (including manufactures)	125.6	353.0	0.356	34.5	3.64	1.03
Wheat	148.6	319.3	.465	44.4	3.34	1.05
Corn	124.1	291.1	.426	40.4	3.07	1.05
Flour, wheat	95.1	568.6	.167	24.3	3.91	.69
Mill products, n. o. s	64.2	407.7	.158	22.3	2.88	.71
Cotton in bales	90.2	410.5	.220	12.2	7.40	1.80
Oranges and grapefruit	471.2	2,125.8	.222	17.7	26.64	1.25
Apples, fresh	236.7	1,162.1	.204	16.2	14.66	1.26
Potatoes, other than sweet	164.3	741.4	.222	17.9	9.17	1.24
Vegetables, fresh, n. o. s	304.8	2,063.3	.148	11.5	26.48	1.28
Cattle and calves, single-deck	78.2	408.6	.192	11.6	6.73	1.65
Hogs, double-deck	99.7	541.2	.184	13.0	7.69	1.42
Fresh meats, n. o. s	188.0	917.6	.205	12.4	15.09	1.65
Anthracite	99.6	174.1	.572	50.8	1.96	1.13
Bituminous coal	124.3	361.9	.343	52.7	2.36	.65
Coke	67.9	182.4	.372	32.8	2.07	1.14
Iron ore	67.4	133.8	.504	60.8	1.11	.83
Copper ore and concentrates	15.2	29.5	.516	55.0	.28	.94
Lead ore and concentrates	37.8	52.1	.726	52.3	.72	1.39
Zinc ore and concentrates	113.6	351.7	.323	49.2	2.31	.66
Ores and concentrates, n. o. s	160.2	478.8	.336	50.8	3.17	.66
Gravel and sand	45.8	69.7	.657	55.7	.82	1.18
Stone: broken, ground, or crushed	49.5	86.4	.574	55.4	.89	1.04
Petroleum: crude	111.1	403.2	.275	34.4	3.23	.80
Asphalt	129.7	295.4	.439	35.1	3.70	1.25
Petroleum oils, refined and all other gasolines	148.9	350.9	.424	28.2	5.27	1.50
Lumber: shingles and lath	154.6	747.0	.207	26.1	5.93	.79
Iron: pig	104.8	202.1	.518	54.0	1.94	.96
Scrap iron and scrap steel	82.8	140.6	.589	42.3	1.96	1.39
Copper: ingot, matte, and pig	359.4	1,181.1	.304	42.8	8.39	.71
Lead and zinc: ingot, pig, or bar	247.4	952.8	.260	42.4	5.83	.61
Aluminum: ingot, pig, or slab	342.0	809.1	.423	26.5	12.93	1.60
Cement: natural or portland	107.0	195.8	.546	38.8	2.76	1.41
Salt	134.5	483.2	.278	29.0	4.67	.96

SOURCE: Federal Coordinator of Transportation, *Freight Traffic Report*, 1935, Appendix 1, pp. 72–75. Data on freight revenue per car-mile and average load per car were calculated from aggregates on originating traffic.

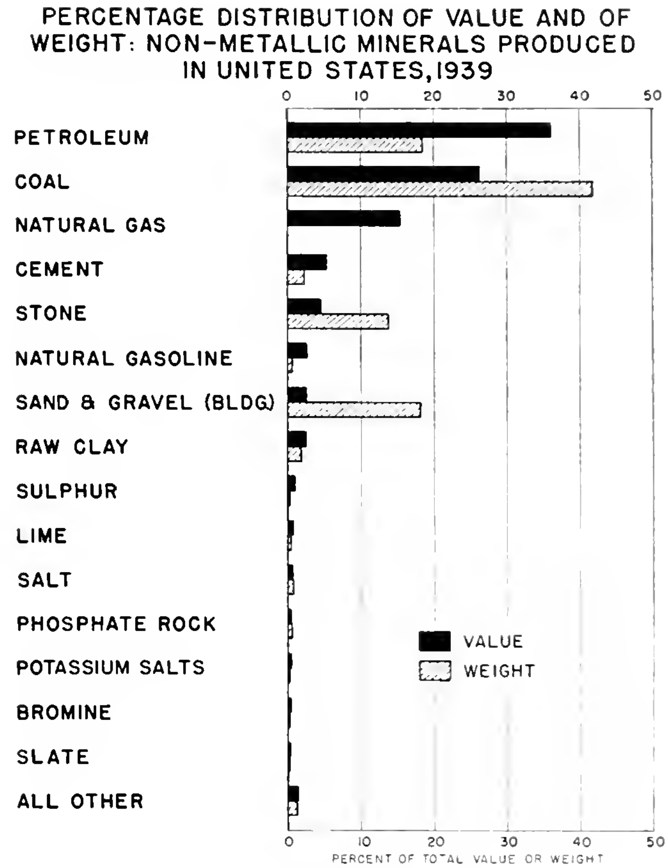


FIGURE 21

Low-cost water transportation of raw materials is important principally for iron ore on the Great Lakes, for coal on the Great Lakes and at Atlantic tidewater, and for oil in the movement from the Gulf coast to the Atlantic coast. Pipe lines also provide low-cost transportation for oil and natural gas. Coal and iron ore are usually hauled by railroad even though they may also be shipped by water, but water routes have had a profound effect on location both directly and through pressure on the railroad rate structure.

The most notable departures from a standardized basis for utilization of resources for industry are the perishable foods, such as milk, meats, and many fruits and vegetables. In fact nonmineral products are to a considerable extent in a class apart from mineral products. Accordingly a separate analysis of nonmineral resources follows.

CHAPTER 2. NONMINERAL RESOURCES

By John K. Rose*

Nearly all of the 3,022,387 square miles of continental United States are productive of some plant or animal products which directly or in derivative form constitute the major portion of the nonmineral industrial resources of our Nation. Year after year there pours out from farm, forest, and ranch a stream of products, much of which constitute, directly or indirectly, raw materials for manufacturing. The annual food-product bulk alone amounts to more than 200 billion pounds. Fibers and other nonfood products make up a lesser bulk but are nevertheless essential raw materials for many economic activities. The inland waters and the more expansive waters of the continental shelf, both inshore and offshore, contribute to the total.

Food

The variety, abundance, and cheapness of food from time to time and place to place are factors in the efficiency and cost of labor and are significant in areal and time cost-differentials of industrial production. More than that, the primary processing of food makes up a significant sector of American industry.

Types and Amounts of Food

Enormous food supplies of great value were available for processing and consumption in 1940, as indicated by the summary figures on the domestic product shown in table 1. Both the weight and value of our food production have reached astronomical figures. Total production in 1940 exceeded 240 billion pounds, of which somewhat under 200 billion pounds were consumed in the United States. The wholesale value of the total product was probably over 10 billion dollars.[1] Animal products had a somewhat lower poundage than plant products, but the ratio of their value to that of plant products was approximately 3 to 2. (The weight and value of some plant products, such as corn, which are chiefly used for animal feed, are included under animal products.) Wheat and dairy products bulked large in total poundage, but meats were by far more valuable. The data also suggest that supplies were not greatly in excess of domestic consumption, except for wheat.

Farm Income by Types of Products

Farm production, in contradistinction to, but inclusive of, food production, is presented in table 2, with a break-down for livestock and crop products. In addition, much is revealed as to the location of the production facilities, insofar as they may be revealed by cash income of farm products by States. It is clear that some sections of the country which stand high in livestock and livestock products (for example, some of the stronger dairying and grazing States) are much less active in producing and marketing crops directly.

Imports and Exports of Food

Our domestically produced food supplies were in 1940 somewhat reduced by export, apparently of materials not urgently needed for home consumption, and they were augmented by import of food products, mostly of types not efficiently produced in the quantity and quality needed for consumption in the United States, particularly products from the Tropics. Exports and imports of food were as follows in 1940:[2]

	Exports	*Imports*
Animals and animal products, edible	\$71,329,239	\$72,746,050
Vegetable food products and beverages	168,601,497	489,809,820

Exports are closely balanced against imports in the case of animal products, whereas in the case of plant foods, of which sugar, coffee, whiskey, and bananas make up a large part of the total, we import much more than we export, except in those years when export wheat is a major factor.

The Producing Machine

Industrially, it is not alone information on the types, amounts, and values of food normally available for processing and consumption that matters, but also the more strictly geographic aspects of the present and future supply. Of basic concern are the questions of where and under what conditions the more important types and amounts of food are produced, and what areas appear to have significant potentials of production for the future. According to the census of 1940 there were 30,151,076 persons living on 6,096,789[3] farm

*Senior Economic Analyst, Rural Electrification Administration.

[1] Comparisons of food supplies with other types of materials are shown in chapter 1, tables 1–3.

[2] *Monthly Summary of Foreign Commerce of the United States*, December 1940, Department of Commerce, Washington, 1941, pp. 6 and 21.

[3] *Sixteenth Census of the United States, 1940, Agriculture*, vol. 1.

TABLE 1.—*Weight and wholesale value of domestic food supplies and apparent domestic consumption, United States, 1940*

Commodity	Total food supplies in the United States	Estimated wholesale value of domestic food supplies	Estimates of apparent domestic consumption of foods
Animal products:	*1,000 pounds*	*1,000 dollars*	*1,000 pounds*
Meats other than poultry	18, 832, 000	2, 694, 813	18, 053, 000
Poultry meats (dressed weight)	2, 828, 000	523, 180	2, 764, 000
Eggs	5, 612, 500	755, 884	5, 112, 500
Butter	2, 395, 000	658, 378	2, 300, 000
Dairy products other than butter, in terms of whole milk	70, 000, 000	1, 274, 833	63, 300, 000
Lard	2, 480, 000	146, 320	2, 080, 000
Fish [1]	1, 500, 000	163, 000	1, 400, 000
Subtotal	103, 647, 500	6, 216, 408	95, 009, 500
Plant products:			
Wheat	66, 060, 000	1, 027, 233	30, 540, 000
Rice	1, 785, 000	66, 045	1, 200, 000
Fruits:			
Fresh	19, 086, 000	700, 000	18, 252, 000
Canned	3, 174, 000	180, 000	2, 760, 000
Dried	1, 275, 200	50, 000	840, 000
Vegetables:			
Fresh	14, 206, 000	675, 000	14, 018, 000
Canned	3, 510, 000	277, 000	3, 180, 000
Potatoes	23, 880, 000	596, 000	20, 280, 000
Sweet potatoes	3, 720, 000	78, 120	3, 000, 000
Dry edible beans	1, 950, 000	75, 055	1, 350, 000
Other domestic edible fats and oils [2]	3, 200, 000	200, 137	2, 125, 000
Subtotal	141, 846, 200	3, 924, 590	97, 545, 000
Grand total	245, 493, 700	10, 140, 998	192, 554, 500

[1] Data on fish are estimates for 1937, Alaska excluded.
[2] Imported edible fats and oils excluded.

SOURCE: Bureau of Agricultural Economics. Computed largely from data in *The National Food Situation*, Jan. 22, 1941, and *Cash Farm Income and Government Payments, 1940*, Feb. 19, 1941; July situation mostly used as base.

units. The producing plant, the land and buildings of these farms, was valued at $33,644,263,274 in 1940. Of that value, buildings amounted to something like one-third, or $10,405,085,980, thus leaving a value of more than $20,000,000,000 for the farm land of the Nation, under conditions that certainly do not represent inflated values. Implements and machinery used in operating the farms amounted to nearly one-third as much as the value of farm buildings, and about one-tenth as much as the value of farm land and buildings taken together, or $3,059,266,327. A comparison of figures 22 and 23 with figure 24 suggests that approximately 90 percent of the 6 million farm units, and a slightly larger percentage of the farm population, are located in the eastern half of the United States and that natural conditions are properly to be associated with much of the asymmetry of those patterns.[4] The rough topography of much of the western half, together with low precipitation and, in some sections, temperature handicaps, have been unfavorable to a dense farm settlement, except in a few sections which have irrigation systems or greater rainfall.

Centralized Interior Pattern of Production

The picture of the food-producing sector of our economy as presented by sheer number of units is in need of considerable refinement, for the farm units from one part to another of the country vary greatly in size and productivity, and some of them, particularly in the Cotton Belt, are specialized in nonfood products. For the United States as a whole, crops such as flax, tobacco, cotton, and other materials occupy normally 8 percent of the crop land. Nor does the income from all farm products as presented in table 2 provide sufficient detail. Food in some amount, variety, and quality is everywhere present, but quantitative productivity is much less evenly distributed. From the standpoint of industrial processing and consumption it is significant that 28 percent of the farm units are estimated to contribute only 3 percent of all farm products "sold or traded," that is, of total commercial production; and nearly half of the farms account for only 11 percent of the commercial product, the remaining half of the farms thereby accounting for

TABLE 2.—*Cash farm income and Government payments, by States, calendar year 1940* [1]

[Thousands of dollars]

State	Income from crops	Income from livestock and livestock products	Cash farm income	Government payments	Cash income and Government payments
Maine	30, 141	23, 278	53, 419	1, 709	55, 128
New Hampshire	6, 102	16, 158	22, 260	401	22, 661
Vermont	7, 531	33, 738	41, 269	595	41, 864
Massachusetts	31, 123	44, 486	75, 609	619	76, 228
Rhode Island	3, 461	6, 428	9, 889	69	9, 958
Connecticut	21, 539	33, 768	55, 307	662	55, 969
New York	103, 474	224, 981	328, 455	6, 211	334, 666
New Jersey	48, 768	55, 994	104, 762	1, 108	105, 870
Pennsylvania	80, 001	191, 989	271, 990	6, 679	278, 669
Ohio	101, 136	228, 119	329, 255	16, 971	346, 226
Indiana	74, 518	209, 550	284, 068	22, 657	306, 725
Illinois	199, 663	336, 211	535, 874	35, 750	571, 624
Michigan	85, 547	117, 963	233, 510	12, 773	246, 283
Wisconsin	38, 637	264, 566	303, 203	12, 273	315, 476
Minnesota	112, 368	275, 630	387, 998	40, 552	428, 550
Iowa	165, 311	513, 960	679, 271	49, 235	728, 506
Missouri	62, 601	214, 405	277, 006	25, 091	302, 097
North Dakota	73, 018	56, 608	129, 626	27, 021	156, 647
South Dakota	31, 342	97, 196	128, 538	20, 016	148, 554
Nebraska	51, 346	180, 826	232, 172	46, 296	278, 468
Kansas	89, 450	165, 624	255, 074	38, 941	294, 015
Delaware	8, 083	10, 822	18, 905	571	19, 476
Maryland	31, 825	37, 726	69, 551	2, 783	72, 334
Virginia	63, 534	57, 380	120, 914	4, 724	125, 638
West Virginia	12, 572	29, 151	41, 723	1, 920	43, 643
North Carolina	168, 301	38, 591	206, 892	14, 876	221, 768
South Carolina	80, 470	18, 760	99, 230	16, 787	116, 017
Georgia	109, 778	33, 851	143, 629	24, 419	168, 048
Florida	90, 002	19, 416	109, 418	4, 068	113, 486
Kentucky	74, 073	72, 434	146, 507	13, 318	159, 825
Tennessee	66, 566	58, 717	125, 283	16, 207	141, 490
Alabama	62, 006	27, 606	89, 612	25, 851	115, 463
Mississippi	81, 629	32, 911	114, 540	32, 681	147, 221
Arkansas	103, 295	37, 736	141, 031	25, 726	166, 757
Louisiana	65, 034	25, 178	90, 212	21, 902	112, 114
Oklahoma	86, 209	88, 839	175, 048	25, 638	200, 686
Texas	262, 653	230, 050	492, 703	86, 489	579, 192
Montana	47, 716	49, 757	97, 473	14, 571	112, 044
Idaho	42, 883	47, 933	90, 816	8, 167	98, 983
Wyoming	9, 511	44, 752	54, 263	3, 684	57, 947
Colorado	47, 359	84, 433	131, 792	10, 112	141, 904
New Mexico	14, 217	40, 723	54, 940	4, 652	59, 592
Arizona	31, 813	24, 850	56, 663	3, 986	60, 649
Utah	11, 846	33, 463	45, 309	2, 830	48, 139
Nevada	1, 633	11, 779	13, 412	226	13, 638
Washington	83, 444	63, 821	147, 265	6, 443	153, 708
Oregon	49, 556	60, 292	109, 848	5, 699	115, 547
California	412, 627	215, 943	628, 570	21, 840	650, 410
United States	3, 535, 712	4, 818, 392	8, 354, 104	765, 799	9, 119, 903

[1] Preliminary.

SOURCE: *Crops and Markets*, Vol. 18, No. 2, Washington, February 1941, p. 38.

[4] The broad distribution of agricultural population and activity is discussed in chapter 3, "Major Groups of Economic Activity."

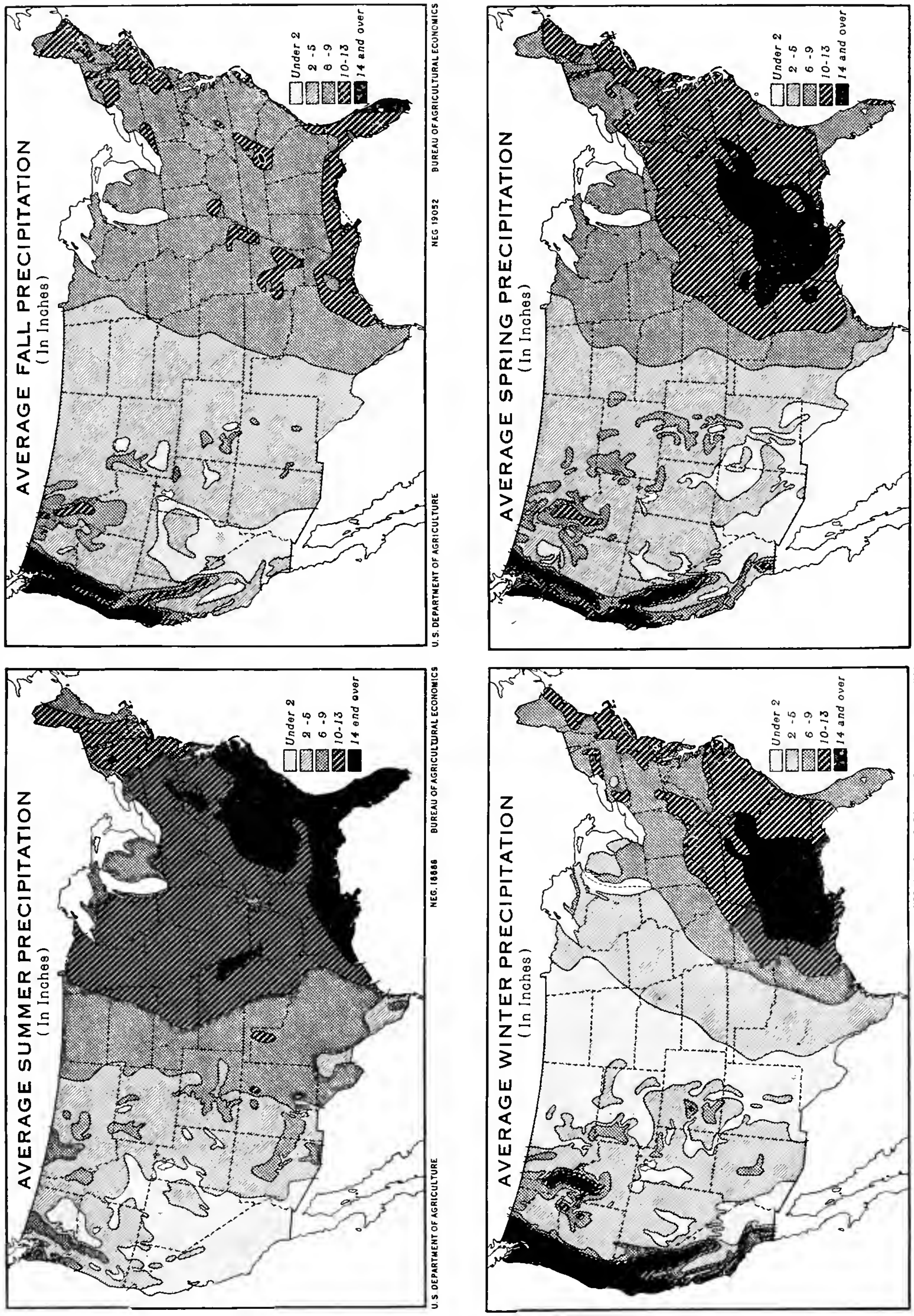
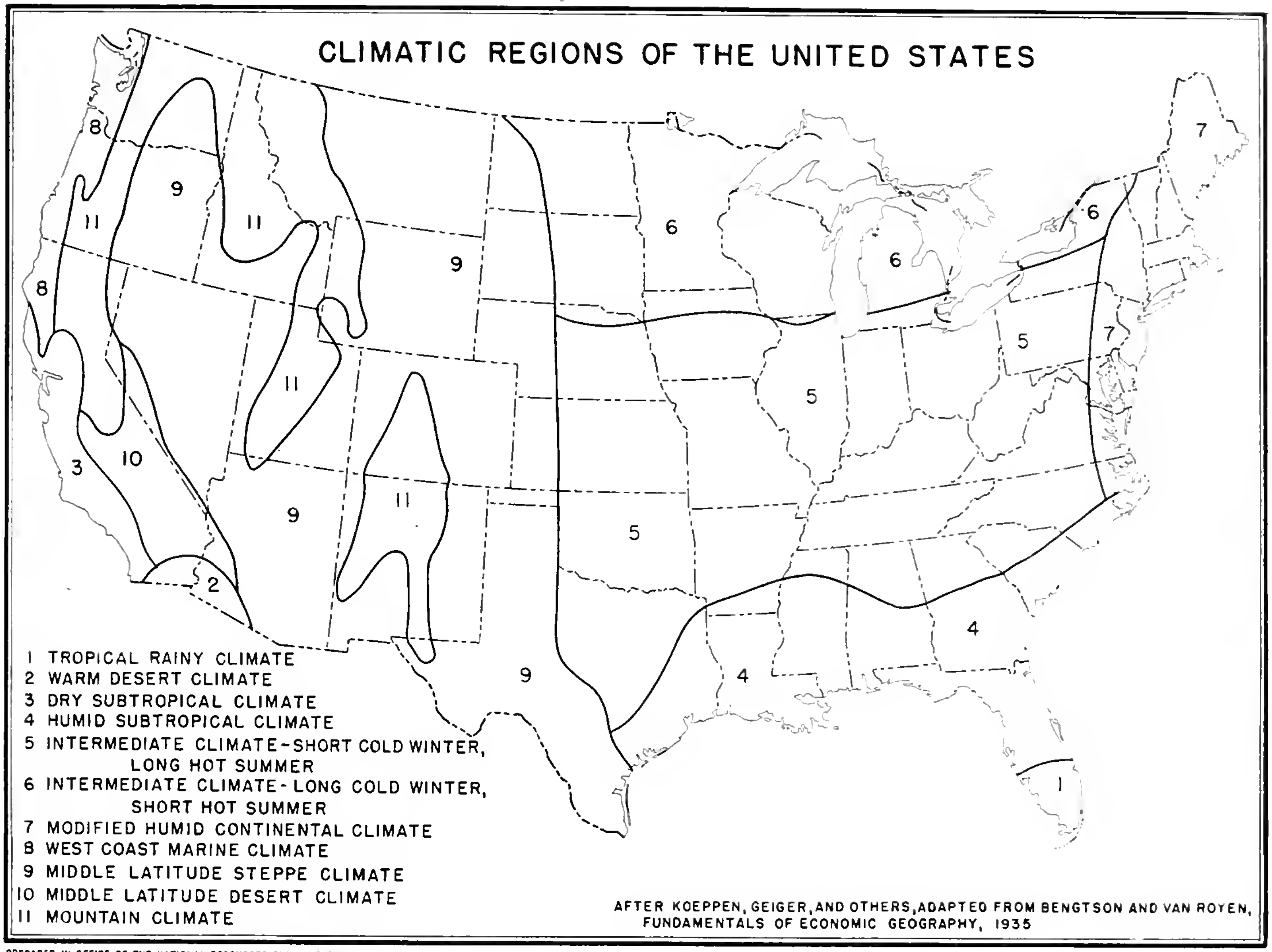

AVERAGE FALL PRECIPITATION
(In Inches)
Under 2
2 - 5
6 - 9
10 - 13
14 and over
U.S. DEPARTMENT OF AGRICULTURE
NEG 19052
BUREAU OF AGRICULTURAL ECONOMICS
AVERAGE SUMMER PRECIPITATION
(In Inches)
Under 2
2 - 5
6 - 9
10 - 13
14 and over
U.S. DEPARTMENT OF AGRICULTURE
NEG. 18886
BUREAU OF AGRICULTURAL ECONOMICS
AVERAGE SPRING PRECIPITATION
(In Inches)
Under 2
2 - 5
6 - 9
10 - 13
14 and over
U.S. DEPARTMENT OF AGRICULTURE
NEG. 18938
BUREAU OF AGRICULTURAL ECONOMICS
AVERAGE WINTER PRECIPITATION
(In Inches)
Under 2
2 - 5
6 - 9
10 - 13
14 and over
U.S. DEPARTMENT OF AGRICULTURE
NEG 18889
BUREAU OF AGRICULTURAL ECONOMICS

FIGURE 22



PREPARED IN OFFICE OF THE NATIONAL RESOURCES PLANNING BOARD

FIGURE 23

nearly nine-tenths of the commercial total.[5] The 3 million only slightly commercial farms are found predominantly in the South and Southern Appalachian areas.

It is a further desirable refinement in the consideration of the location and nature of our food-producing resources to observe data on acreage of land available for crops, acreage of crops harvested, cash farm income in relation to total area, and the number of farms, as presented in table 3. All of these data indicate that, whereas most of the farm units are located in the eastern half of the United States, and nearly half in the South and Southeast, food productivity, so far as it can be measured in terms of available or harvested crop, acreage, or the relative income therefrom, is noticeably higher in portions of the middle or interior of the country than in the more peripheral areas. This centralized pattern would be even more noticeable if food products alone could be considered, for the Southeast, with many farm units and a comparatively large amount of land in production, utilizes a considerable fraction of its harvested acreage primarily for cotton. This quantitative predominance of our midlands in food production is indirectly but strikingly illustrated in figure 24; that is, farm property values reflect not only natural fertility and the production of the past which has been reinvested in improvements, but also man's judgment of future productivity. The outstanding nature of the food-producing facilities of the East North Central and West North Central portions of the United States may be summarized roughly by indicating that this middle area, which is 25 percent of the Nation's areal

[5] O. E. Baker and Conrad Taeuber, "The Rural People," in *Farmers in a Changing World, Yearbook of Agriculture, 1940*, U. S. Department of Agriculture, p. 8344.

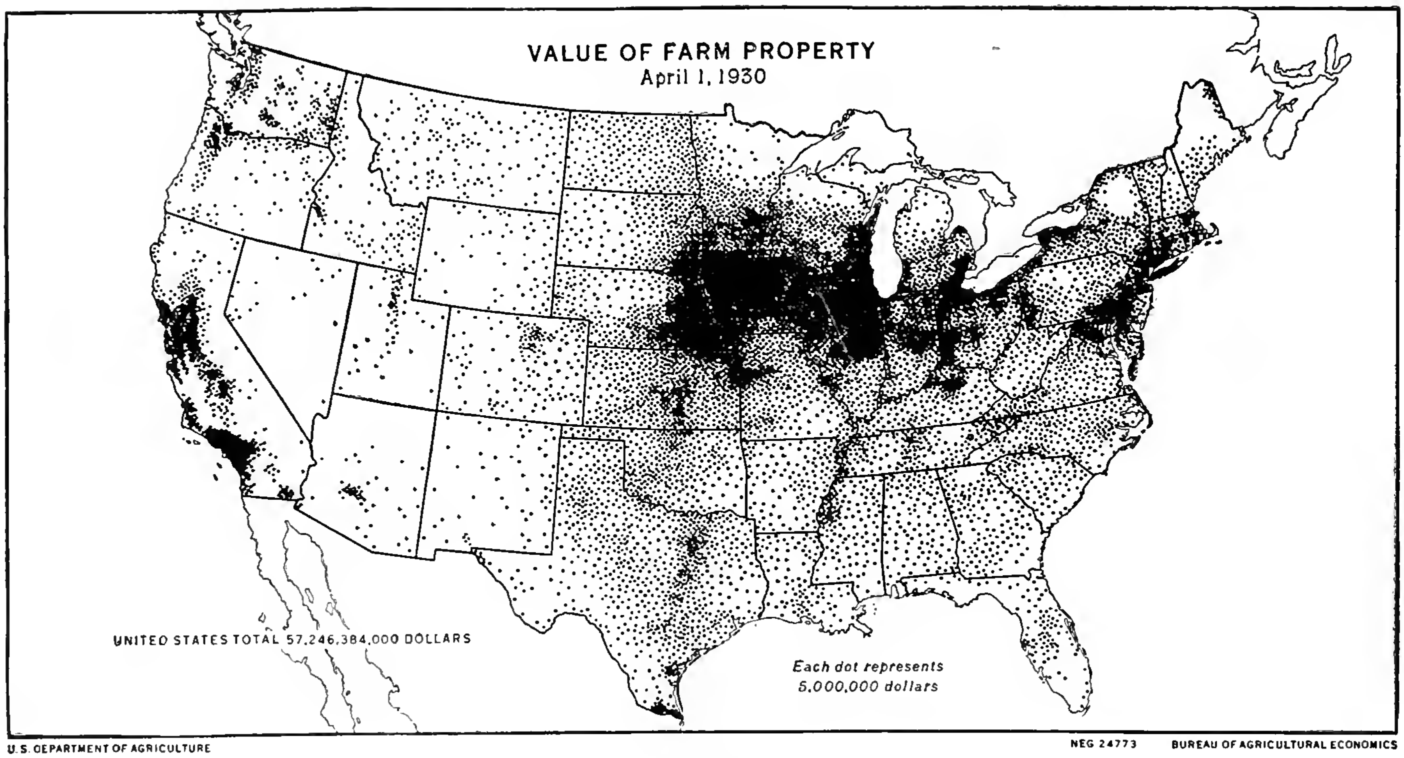


FIGURE 24

total, has 34 percent of the Nation's farms, 50 percent of the total acreage available for crops, 53 percent of the harvested crop acreage, and 45 percent of the cash farm income.

Production Facilities in Reserve

Food production facility reserves may be examined from at least four points of view: (1) How many additional acres are available for cultivation or may be made available for cultivation; (2) what is the present status of land quality, trend thereof, and practical possibilities of improving quality; (3) may production be increased by more intensive cropping and by technological and genetic improvements; (4) to what extent may certain crop areas be feasibly expanded if desired?

Though more than half of the land in farms, 530,131,043 acres, or about 28 percent of our total acreage, is indicated as available for crops (distribution shown in table 3), the total harvested acreage of the principal crops in 1940 was only 333,825,300 acres, the difference being due to crop failure, idle or fallow land, plowable pasture, or land devoted to minor crops. It is not to be supposed that this gap could be completely closed, for crop failure is sometimes unavoidable, fallowing may in the long run increase productivity, and to reduce all plowable pasture to crop land would merely substitute crops for grass already used for food production by live stock. Of the total acreage used in food production, it has been estimated that 73 percent was productive of animal products; 21 percent of cereals; 4 percent of vegetables; and 2 percent of fruit.[6] Of the acreage harvested, it is estimated, after some adjustment, that more than 78 percent is devoted to products for domestic human consumption, nearly 9 percent to products for export, and 14 percent to food for work stock.[7] The portions used by work stock and exported might in part at least be drawn upon by domestic industry in case of need. Of the more than 1,500,000,000 acres considered as agricultural, only a little over 1,000,000,000 acres (Census of 1940) are in farms and something like 100,000,000 acres[8] of the farm land are in woods not even pastured.

A wide degree of variability in productivity is present in our land, not only as to whether it is crop land at all, but as to what crops it will best produce, and also as to how much and what quality of a particular crop may normally be produced per unit area. In table 4, an inventory of the land-productivity classes of the Nation by States is shown. In this classification the principal physical conditions influencing productivity, such as soil type, topography, rainfall, and temperature,

[6] *Agricultural Land Requirements and Resources*, Part III of the Supplementary Report of the Land Planning Committee to the National Resources Board, Washington, 1935, p. 2 (cited subsequently by title).

[7] H. R. Tolley, "An Appraisal of the National Interest in the Agricultural Situation," *American Economic Review*, Vol. XXX, No. 5 (proceedings number), February 1941, p. 112.

[8] *Agricultural Land Requirements and Resources*, p. 30.

TABLE 3.—*State comparisons of certain aspects of agricultural productivity*

State	Total acreage [1]	Acreage available for crops (1940) [2]	Total harvested acreage of principal crops (1940) [3]	Cash farm income (1940) [4]	Cash farm income per acre of total area (1940)	Cash farm income per acre of land available for crops (1940)	Cash farm income per acre of harvested principal crops (1940)
United States	1,903,217,000	530,131,043	333,825,300	$8,354,104,000	$4.39	$15.76	$25.03
Maine	19,133,000	1,589,362	1,343,000	53,419,000	2.79	33.61	39.78
New Hampshire	5,780,000	590,375	427,900	22,260,000	3.85	37.70	52.02
Vermont	5,839,000	1,478,066	1,093,300	41,269,000	7.07	27.92	37.75
Massachusetts	5,145,000	787,815	483,100	75,609,000	14.70	95.97	156.51
Rhode Island	683,000	93,211	60,500	9,889,000	14.48	106.09	163.45
Connecticut	3,085,000	642,070	450,300	55,307,000	17.93	86.14	122.82
New England	39,665,000	5,180,899	3,858,100	257,753,000	6.50	49.75	66.81
New York	30,499,000	10,236,846	6,690,600	328,455,000	10.77	32.09	49.09
New Jersey	4,809,000	1,156,652	734,000	104,762,000	21.78	90.57	142.73
Pennsylvania	28,692,000	9,240,159	6,211,300	271,990,000	9.48	29.44	43.79
Middle Atlantic	64,000,000	20,633,657	13,635,900	705,207,000	11.02	34.18	51.71
Ohio	26,074,000	15,657,989	10,191,000	329,255,000	12.63	21.03	32.31
Indiana	23,069,000	14,649,999	10,047,800	284,068,000	12.31	19.39	28.27
Illinois	35,868,000	25,133,474	18,532,900	535,874,000	14.94	21.32	28.91
Michigan	36,787,000	11,898,762	7,707,000	233,510,000	6.35	19.62	30.30
Wisconsin	35,364,000	13,037,946	10,165,800	303,203,000	8.57	23.26	29.83
East North Central	157,162,000	80,378,170	56,644,500	1,685,910,000	10.73	20.97	29.76
Minnesota	51,749,000	22,974,024	19,114,000	387,998,000	7.50	16.89	20.30
Iowa	35,575,000	27,547,835	20,961,000	679,271,000	19.09	24.66	32.41
Missouri	43,985,000	23,007,358	12,192,000	277,006,000	6.30	12.04	22.72
North Dakota	44,917,000	27,100,920	16,917,200	129,626,000	2.89	4.78	7.66
South Dakota	49,194,000	23,169,296	13,651,600	128,538,000	2.61	5.55	9.42
Nebraska	49,157,000	25,414,860	17,321,700	232,172,000	4.72	9.14	13.40
Kansas	52,335,000	34,193,430	20,324,300	255,074,000	4.87	7.46	12.55
West North Central	326,912,000	183,407,723	120,481,800	2,089,685,000	6.39	11.39	17.34
Delaware	1,258,000	569,583	366,300	18,905,000	15.03	33.19	51.61
Maryland, District of Columbia	6,402,000	2,586,046	1,679,200	69,551,000	10.86	26.89	41.42
Virginia	25,768,000	7,962,361	3,791,000	120,914,000	4.69	15.19	31.90
West Virginia	15,374,000	3,861,054	1,491,600	41,723,000	2.71	10.81	27.97
North Carolina	31,194,000	8,422,275	6,461,800	206,892,000	6.63	24.56	32.02
South Carolina	19,517,000	5,529,838	5,124,000	99,230,000	5.08	17.94	19.37
Georgia	37,584,000	11,690,225	10,673,100	143,629,000	3.82	12.29	13.46
Florida	35,111,000	2,856,588	1,620,100	109,418,000	3.12	38.30	67.54
South Atlantic	172,208,000	43,477,965	31,207,100	810,262,000	4.71	18.64	25.96
Kentucky	25,716,000	13,212,628	5,329,900	146,507,000	5.70	11.09	27.49
Tennessee	26,680,000	11,159,154	6,112,500	125,283,000	4.70	11.23	20.50
Alabama	32,819,000	10,397,273	7,847,500	89,612,000	2.73	8.62	11.42
Mississippi	29,672,000	10,702,733	7,167,000	114,540,000	3.86	10.70	15.98
East South Central	114,887,000	45,471,788	26,456,900	475,942,000	4.14	10.47	17.99
Arkansas	33,616,000	10,190,407	6,146,000	141,031,000	4.20	13.84	22.95
Louisiana	29,062,000	6,038,067	4,155,000	90,212,000	3.10	14.94	21.71
Oklahoma	44,396,000	19,661,363	13,208,000	175,048,000	3.94	8.90	13.25
Texas	167,963,000	46,261,857	25,826,200	492,703,000	2.93	10.65	19.08
West South Central	275,037,000	82,151,694	49,335,200	898,994,000	3.27	10.94	18.22
Montana	93,524,000	14,789,043	6,675,000	97,473,000	1.04	6.59	14.60
Idaho	53,347,000	4,708,143	2,724,000	90,816,000	1.70	19.29	33.34
Wyoming	62,431,000	3,513,414	1,868,200	54,263,000	.87	15.44	29.05
Colorado	66,341,000	12,898,689	5,559,200	131,792,000	1.99	10.22	23.71
New Mexico	78,402,000	4,572,698	1,372,200	54,940,000	.70	12.01	40.04
Arizona	72,838,000	992,631	665,400	56,663,000	.78	57.08	85.16
Utah	52,598,000	1,762,296	1,042,000	45,309,000	.86	25.71	43.48
Nevada	70,285,000	861,638	372,300	13,412,000	.19	15.57	36.02
Mountain	549,766,000	44,098,552	20,278,300	544,668,000	.99	12.35	26.86
Washington	42,775,000	7,180,154	3,547,800	147,265,000	3.44	20.51	41.51
Oregon	61,188,000	5,255,467	2,624,700	109,848,000	1.80	20.90	41.85
California	99,617,000	12,894,974	5,755,000	628,570,000	6.31	48.75	109.22
Pacific	203,580,000	25,330,595	11,927,500	885,683,000	4.35	34.96	74.26

[1] This column has not been corrected to correspond with the recent census revisions.
[2] SOURCE: Census of 1940.
[3] SOURCE: *General Crop Report*, December 1940, U. S. Department of Agriculture, Bureau of Agricultural Economics, p. 47.
[4] SOURCE: *Crops and Markets*, vol. 18, No. 2, Washington, D. C., February 1941, p. 38.

have been considered. It is assumed that the input of labor and capital will be that most nearly capable of maintaining the natural level of productivity, but without irrigation, additional drainage, or the addition of lime fertilizer or other amendments except nitrogen-fixing legumes. Thus, the intensity of input would approximate roughly what might be considered as the average for the country as a whole. For example, irrigated lands are rated somewhat unrealistically according to their conditions prior to irrigation, rather than subsequently. The grades range from 1 to 5, 1 being the most productive land; the first four grades (1, 2, 3, and

TABLE 4.—*Preliminary inventory of land productivity classes of the United States*

State and geographic division	Total area (acres)	Excellent—Grade 1		Good—Grade 2		Fair—Grade 3		Summary—Grades 1-3		Poor—Grade 4		Nontillable—Grade 5	
		Acres	Percent [1]	Acres	Percent [1]	Acres	Percent [1]	Acres	Percent [1]	Acres	Percent [1]	Acres	Percent [1]
United States	1,902,138,688	101,037,573	5.3 100.0	210,934,728	11.1 100.0	345,871,800	18.2 100.0	657,844,101	34.6 100.0	362,559,173	19.1 100.0	881,735,414	46.4 100.0
Maine	19,172,800			1,615,033		3,788,506		5,403,539		5,791,456		7,977,805	
New Hampshire	5,759,840	2,330		237,212		370,426		609,968		1,671,601		3,478,271	
Vermont	5,839,360	33,217		900,588		1,268,238		2,202,043		2,185,398		1,451,919	
Massachusetts	5,058,560	11,906		759,807		1,274,906		2,046,619		1,644,453		1,367,488	
Rhode Island	682,880			5,463		228,082		233,545		71,019		378,316	
Connecticut	3,102,080	48,452		338,620		902,062		1,289,134		962,120		850,826	
New England	39,615,520	95,905	.2 .09	3,856,723	9.7 1.8	7,832,220	19.8 2.3	11,784,848	29.7 1.8	12,326,047	31.1 3.4	15,504,625	39.1 1.8
New York	30,304,832	94,037		6,863,934		9,248,628		16,206,599		9,172,273		4,925,960	
New Jersey	4,763,560	6,272		943,268		963,896		1,913,436		1,379,108		1,471,016	
Pennsylvania	28,760,428	177,151		6,268,104		9,496,900		15,942,155		5,908,804		6,909,469	
Middle Atlantic	63,828,820	277,460	.4 .3	14,075,306	22.1 6.7	19,709,424	30.9 5.7	34,062,190	53.4 5.2	16,460,185	25.8 4.5	13,306,445	20.8 1.5
Ohio	26,072,600	4,214,074		6,234,205		10,439,723		20,888,002		3,809,973		1,347,625	
Indiana	23,034,624	5,262,498		6,438,377		7,743,581		19,444,456		2,436,801		1,153,367	
Illinois	35,429,912	14,777,030		6,847,145		6,223,171		27,847,346		6,621,568		960,998	
Michigan	37,051,336	2,251,155		8,961,198		5,386,738		16,599,091		7,228,991		13,223,254	
Wisconsin	35,582,580	2,820,276		14,529,981		8,396,995		25,747,252		4,564,307		5,271,021	
East North Central	157,171,052	29,325,033	18.7 29.0	43,010,906	27.4 20.4	38,190,208	24.3 11.0	110,526,147	70.3 16.8	24,661,640	15.7 6.8	21,983,265	14.0 2.5
Minnesota	51,716,214	12,022,243		12,138,815		7,511,325		31,672,383		6,898,992		13,144,839	
Iowa	35,633,920	25,983,110		6,906,158		1,392,680		34,281,948		1,007,416		344,556	
Missouri	43,985,086	8,674,763		13,833,050		12,303,627		34,811,440		4,258,868		4,914,778	
North Dakota	44,913,036			7,365,682		17,715,865		25,081,547		14,151,534		5,679,955	
South Dakota	49,161,600	3,052,320		8,775,365		8,960,392		20,788,077		15,552,419		12,821,104	
Nebraska	49,116,928	8,120,907		9,690,068		9,639,648		27,450,623		10,908,321		10,757,984	
Kansas	52,204,416	3,765,287		15,172,236		15,964,703		34,902,226		11,207,323		6,094,867	
West North Central	326,731,200	61,618,630	18.9 61.0	73,881,374	22.6 35.0	73,488,240	22.5 21.2	208,988,244	64.0 31.8	63,984,873	19.6 17.6	53,758,083	16.5 6.1
Delaware	1,263,360			222,080		350,784		572,864		417,216		273,280	
Maryland and District of Columbia	6,295,744	143,732		1,874,527		1,445,544		3,463,803		1,859,409		972,532	
Virginia	25,644,864			3,653,134		9,279,761		12,932,895		7,312,200		5,399,769	
West Virginia	15,200,288	388,551		1,350,227		2,986,643		4,725,421		7,647,077		2,827,790	
North Carolina	31,193,840			1,166,506		11,360,152		12,526,658		9,381,729		9,285,453	
South Carolina	19,517,208			296,359		7,069,969		7,366,328		7,127,990		5,022,890	
Georgia	37,584,568			1,851,537		15,614,067		17,465,604		9,750,361		10,368,603	
Florida	34,903,454	71,161		933,187		3,928,412		4,932,760		12,892,726		17,077,968	
South Atlantic	171,603,326	603,444	.4 .6	11,347,557	6.6 5.4	52,035,332	30.3 15.0	63,986,333	37.3 9.7	56,388,708	32.9 15.6	51,228,285	29.9 5.8
Kentucky	25,623,680	863,916		5,020,424		8,956,319		14,840,659		7,905,826		2,877,195	
Tennessee	26,629,376	902,258		4,769,847		9,305,437		14,977,542		8,239,726		3,412,108	
Alabama	32,751,820			3,002,499		9,528,183		12,530,682		10,730,251		9,490,887	
Mississippi	29,815,218	844,230		5,336,459		8,614,697		14,795,386		10,928,882		4,090,950	
East South Central	114,820,094	2,610,404	2.3 2.6	18,129,229	15.8 8.6	36,404,636	31.7 10.5	57,144,269	49.8 8.7	37,804,685	32.9 10.4	19,871,140	17.3 2.3
Arkansas	33,643,368	1,452,484		7,952,405		9,231,149		18,636,038		8,299,905		6,707,425	
Louisiana	29,075,904	1,289,430		2,972,742		7,346,623		11,608,795		12,442,991		5,024,118	
Oklahoma	44,446,144	1,700,604		12,795,160		15,268,765		29,764,529		7,825,536		6,856,079	
Texas	168,074,368	1,591,147		19,460,508		54,974,391		76,026,046		35,950,166		56,098,156	
West South Central	275,239,784	6,033,665	2.2 6.0	43,180,815	15.7 20.5	86,820,928	31.5 25.1	136,035,408	49.4 20.7	64,518,598	23.4 17.8	74,685,778	27.1 8.5
Montana	93,370,240					7,366,681		7,366,681		30,438,292		55,565,267	
Idaho	53,346,560			87,288		949,208		1,036,496		3,728,908		48,581,156	
Wyoming	62,414,720					522,936		522,936		4,577,769		57,314,015	
Colorado	66,341,120			285,670		7,041,281		7,326,951		13,743,839		45,270,330	
New Mexico	78,401,920					914,304		914,304		6,060,758		71,426,858	
Arizona	72,865,400									949,313		71,916,087	
Utah	52,597,760									1,233,459		51,364,301	
Nevada	70,285,380									76,900		70,208,480	
Mountain	549,623,100			372,958	.1 .2	16,794,410	3.1 4.9	17,167,368	3.1 2.6	60,809,238	11.1 16.8	471,646,494	85.8 5.35
Washington	42,759,552	83,520		542,138		6,537,431		7,163,089		6,760,172		28,836,291	
Oregon	61,128,960	352,536		2,059,425		4,694,454		7,096,415		5,464,700		48,567,845	
California	99,617,280	46,976		478,297		3,364,517		3,889,790		13,380,327		82,847,163	
Pacific	203,505,792	473,032	.2 .5	3,079,860	1.5 1.5	14,596,402	7.2 4.2	18,149,294	8.9 2.8	25,605,199	12.6 7.1	159,751,299	78.5 18.1

[1] The upper figure is the percent of the total acreage of a given area which is of a particular land-productivity class, and the lower figure is the percent of the total of each land-productivity class which is found in a specified area.

SOURCE: Adapted from the National Resources Board, *Report on National Planning and Public Works*, Washington, Dec. 1, 1934, table 7, p. 127.

4) are regarded as capable of producing cultivated crops without irrigation when cleared. Grade 1, roughly, is excellent for staple crops climatically adapted to the region; grade 2 is good; grade 3 is fair; grade 4 is poor; and grade 5 is essentially incapable of tillage. Grade 4, however, comprising a little more than one-third of a billion acres, is distinctly low in physical productivity and is undesirable for standard arable farming except where uncommonly favored by compensating economic advantages such as nearness to urban markets. Nearly one-half of the United States is put in grade 5, consisting of land practically incapable of producing cultivated crops, because of aridity, poor drainage, rough surface, or shallow or sterile soil; this constitutes, then, the nearly irreducible minimum of area, the highest feasible use of which is, for the most part, grazing or forestry. More than two-thirds of these grade 5 areas, about 600 million acres in all, consist of arid lands of the Western States, mostly not in farms. Grade 4, which is physically capable of producing crops, contributes the greater part of the uneconomic arable farms, sometimes called marginal or submarginal farms.

The wide variability of the several sections of the country in respect to first- and second-rate land can be easily noted from the table. Whereas Iowa alone contains 25 percent of all the grade 1 land, none of the land in the Mountain States is naturally (without irrigation) grade 1, and the Pacific Coast area contains less than one-half of one percent of the Nation's total of such land. In the long-farmed Northeastern States, only seven-tenths of 1 percent of their total land area is classed as excellent. An examination of table 4 indicates that 33 percent of the class 1, 2, and 3 soils are included in those 21 States which touch the oceans or the Gulf; these same States constitute but 36 percent of the total area of the United States, thus suggesting that the better soils are comparatively evenly distributed between the interior and the periphery of the country. However, a large portion of the western interior is automatically ruled out of class 1, 2, or 3 because of its lack of sufficient precipitation, thus reducing the status of the interior but not lessening the high quality of the East North Central and West North Central sections which contain 90 percent of the class 1 land found in the United States.

The quality of land may be improved by conservation, by slowing up the depletion and destruction of land by erosion, by replacing used or lost nitrates and humus by legumes, and by adding missing phosphates, lime, and potash in selected fertilizers. That the net result of land-use practices has been soil erosion, depletion, and deterioration, not conservation and improvement, is evident: 50,000,000 acres of once productive crop land is now essentially ruined; another 50,000,000 acres is nearly as depleted; and at least 500,000 farmers are attempting to farm land which is so poor and eroded as to offer no chance of yielding an American standard of living.

The increased production of food from a given acreage sometimes quite unrelated to increased soil fertility (in many cases depleting the present fertility more rapidly than would otherwise be the case), is in many instances a result of improvement, genetically, of crop species—hybrid corn being the present best example. These factors in general appear to increase the normal spread of productivity between good and poorly productive soil.

The problem of the adequacy of the potential food supply for future industrial processing and consumption has been discussed or referred to in several recently published studies,[9] but is highly complex because of the indeterminate nature of related problems. Variable exports and imports, crop failure, mechanization, changes in diet, farmer and consumer psychology, industrial diversion, standard of living, fertilization, conservation, the retirement of poorly productive acres, technology and genetics, population trends, all of these and others are factors having major or minor relation to the food-producing sector of our industrial economy. So far as the recent past and the present are concerned, the reverse of the expected Malthusian man-to-land ratio trend would appear to be the case—we apparently have available surplus crop acres numbering many millions, to say nothing of other acres which are not being adequately used.

The Corn Belt

Farmers have long experimented with the soils of many parts of the United States and no large areas have been found to be so regularly and largely productive as the deep, glacial till soils of the Corn Belt, predominantly of the blackish-brown Prairie type (fig. 25). Though corn is the leading cereal generally in the eastern half of the United States, it reaches its peak, both as to percent of total acres occupied and total production, in this interior section, which has elsewhere been noted as agriculturally outstanding in soil productivity, farm property values, and farm income. In this area man and land have fared well, erosion is

[9] H. E. Selby, "How Many Acres Do We Require?", *Land Policy Review*, vol. III, No. 5, September 1940, pp. 8–11.

Oris V. Wells, "How Many Farmers Do We Require?", *Land Policy Review*, vol. III, No. 5, September 1940, pp. 3–7.

Agricultural Land Requirements and Resources, Part III of the Supplementary Report of the Land Planning Committee to the National Resources Board, Washington, 1935.

H. R. Tolley, *op. cit.*

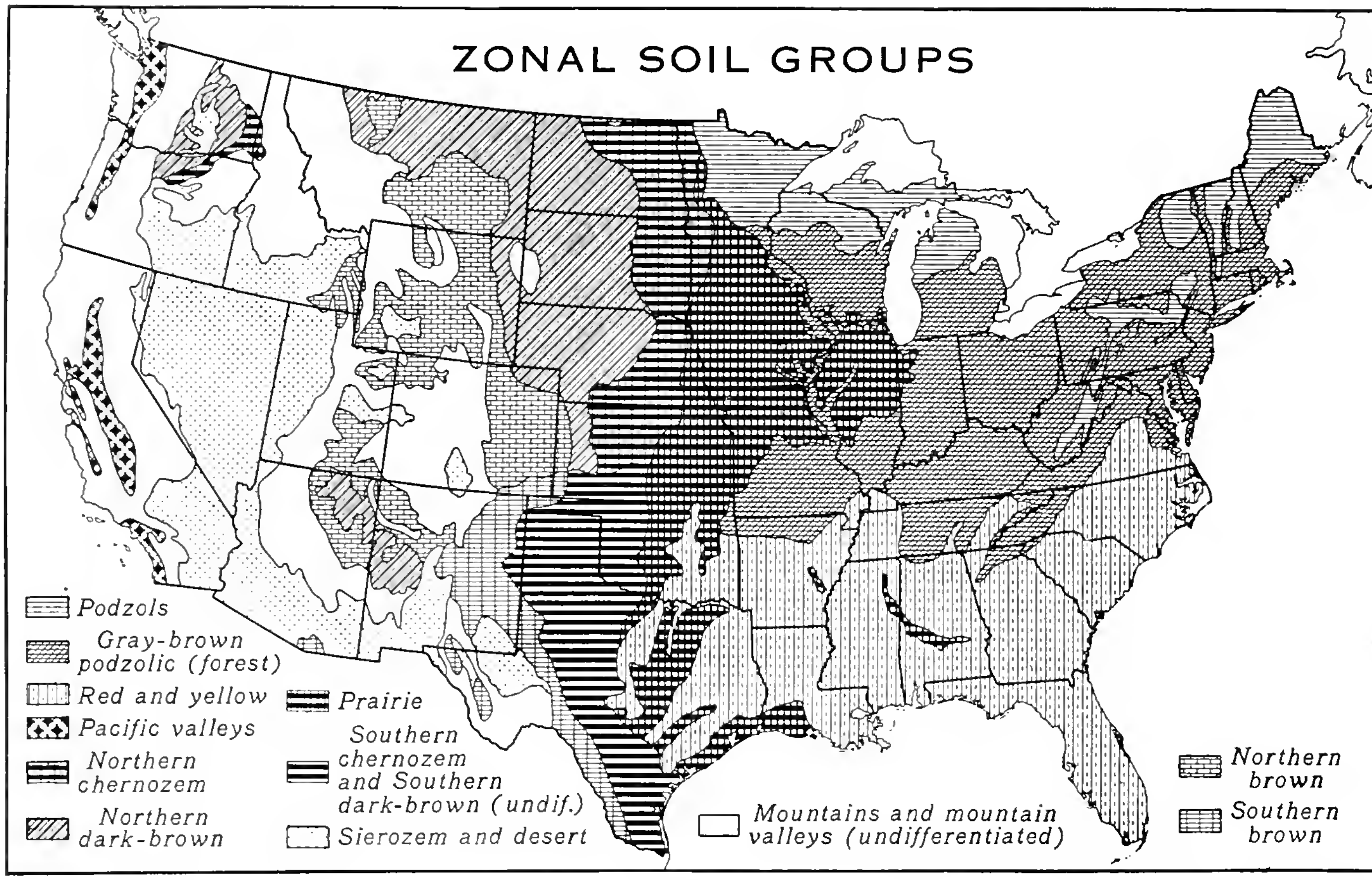


FIGURE 25

moderate, and incomes are substantial. The soils, supercharged with nitrogen, nevertheless do not have phosphorus and lime in particular abundance. The area is definitely interior with all that this implies for economic, social, and governmental orientation. Yet the area has an interest in world markets, notably in the export of pork products, although this trade has fallen to about one-tenth its former volume. While the major center is Chicago, the agricultural economy is not tied to any one city but rather utilizes a score of secondary and numerous tertiary centers. Here a rich agriculture is interwoven with an increasingly complex industrial pattern.

The Corn Belt makes its largest and most significant contribution to our food supply through the high-grade meats it produces, which are the derivatives of the corn, pasture, and hay of the area. Though the area contains less than half of the national acreage devoted to corn, it nevertheless provides more than 60 percent of that crop in terms of grain harvested (fig. 26). Nearly 90 percent of the corn produced there, as well as oats (fig. 30) and other cereals and hay available in abundance, are used as feed in the area where grown. Of the 50 to 60 million head of swine normally found on farms, about two-thirds are in the Corn Belt (fig. 27), where commonly, due to the abundance of fat-producing corn, the animals are fed to a heavier weight than elsewhere. Cattle, particularly fat cattle, are a major product of the western Corn Belt, to which in part grass-grown animals are imported from the range country to be fattened. The over-all density of cattle in the Corn Belt, shown in figure 28, is greater than in the Dairy Belt, amounting to something like 45 head per square mile—fully as high as the population density. Poultry and its products are more abundant than in most other sections of the country, and sheep are numerous in some sections (figs. 31, 32, 29).

As may be seen in figure 26, corn is not sharply limited in its general distribution, but the geographic and competitive location factors giving rise to the intensive core of the distribution are complex. The Corn Belt area appears to be limited on the north by short growing season and low temperatures; on the west, by low rainfall and high temperatures; on the south, by rougher topography, competition with other crops, and possibly, to some extent, by high-temperature con-

ditions; and on the east, by rougher topography and competition.[10] Certain changes have taken place in the past decade, including the rapid expansion in use of the higher producing hybrid corn, mechanization, especially of the corn-picking operation, and a moderate northern migration of production. Corn is also involved directly in industrial processing into many products, including alcohol, industrial chemicals, and foods.

The soybean, as a commercial crop for industrial processing, is largely a product of the Corn Belt. The Corn Belt, in its agricultural richness and diversity, should be able to support many more people directly on substantial levels of nourishment, particularly if its cereals were used directly as food rather than indirectly as meat. Even in those localized sections of the Belt where corn growing is most intense, less than 50 percent of the acreage is producing corn at any one time, and for the Belt as a whole the average is much lower. However, a better possibility of expanding corn production, at least in terms of acreage, appears to lie in the use of unneeded cotton acreage south of the Corn Belt. This has been a moderate trend in recent years, perhaps partly a result of Government agricultural programs.

The "Corn and Winter Wheat" Belt, located south and southeast of the main Corn Belt, is a diverse area in which corn, livestock, wheat, and tobacco, are major farm activities. Unglaciated topography and residual soils cause this diverse agricultural area to stand in considerable contrast with the Corn Belt, having generally smaller fields and farms, as well as a lower percentage of its total area classed as crop land.

Dairy Areas

Agriculture in the Lake States and the Northeast, and to a moderately lesser degree in the North Pacific regions, is of general and mixed farming types devoted largely to pasture, hay, and ensilage crops. Whether milk is sold fresh to village and urban consumers or in the form of processed milk, butter, or cheese depends more upon location in relation to consuming markets than upon stage of development or historical production. By nature the land of these areas is not for the most part of a quality to be compared with the greater part of the Corn Belt; the mantle of glacial till is thinner, the soils are partly the acidic podsols but in greater part the grey-brown forest soils, in some places stony or sandy. Topography in part of the area is rolling to rugged. Nights are cool even in summer, and the generally humid climate promotes the growth of grass. In the western area the mild winter is a favorable factor.

Even more significant as a basic factor in the case of the Lake States and the Northeast regions are their great industrial populations who in recent years have learned to use increasingly large amounts of dairy products. Parts of the same areas are engaged in intensive poultry production. In areas especially favored by temperature, fruit farming predominates over general farming. There appears to be good evidence that, if demands justify, the territory devoted to dairying could be expanded rather easily, particularly into parts of the Corn Belt and, perhaps more desirably so far as national considerations and conservation are concerned, into the Cotton Belt.

Wheat Regions

Wheat and, to a lesser extent, other small cereal grains, including grain sorghums, have come to be the predominant crops in portions of the Northern and Southern Great Plains as well as in a smaller area in the Pacific Northwest (fig. 33). These areas comprise more than 200 million acres, of which less than 90 million are classed as crop land. In any year, from two-fifths to nearly one-half of that crop acreage may be sown to wheat, constituting about 60 percent of the total United States acreage devoted to wheat. The Plains areas are producers of hard wheats, nearly one-third of which is of the spring wheat type.

Judging by maps prepared by the Food Research Institute,[11] or the wheat crop insurance premium data, these areas are not especially favorable climatically to wheat production, but they will produce wheat better, and sometimes more profitably, than other cultivated crops, except perhaps the newer and drought-resistant grain sorghums. Competitive uses of the area are grazing and, in some places, growing of corn, flax, and other cereals. In other words, these wheat areas, in part at least, tend to occupy the dryer margins of the chief agricultural sections of the Nation,[12] and have at times expanded into the more strictly grazing area of the West, only now and again to be pushed back eastward somewhat by a serious drought.[13] The stability of wheat production probably could be and may be increased by further advances in the development of drought- and rust-resistant species. Additional expansion would

[10] V. C. Finch and O. E. Baker, *Geography of the World's Agriculture*, Washington, 1917, p. 32.

J. K. Rose, "Climate and Corn Yield in the Corn Belt," *Geographical Review*, vol. XXVI, No. 1, January 1936, pp. 88–102.

Naum Jasny, *Competition Among Grains*, Food Research Institute, Stanford University, California, 1940.

E. Huntington, F. E. Williams, and S. Van Valkenburg, *Economic and Social Geography*, J. Wiley & Sons, New York, 1933, 614 pages. See especially ch. IV, "Climatic Optima of Crops as Illustrated by Corn," pp. 52–73.

[11] M. K. Bennett and Helen C. Farnsworth, "World Wheat Acreages, Yield, and Climates," Food Research Institute, Stanford University, *Wheat Studies*, Vol. XIII, No. 6, March 1937.

[12] Naum Jasny, *op. cit.*

[13] C. Warren Thornthwaite, "The Great Plains," in Carter Goodrich and others, *Migration and Economic Opportunity*, University of Pennsylvania Press, Philadelphia, 1936.

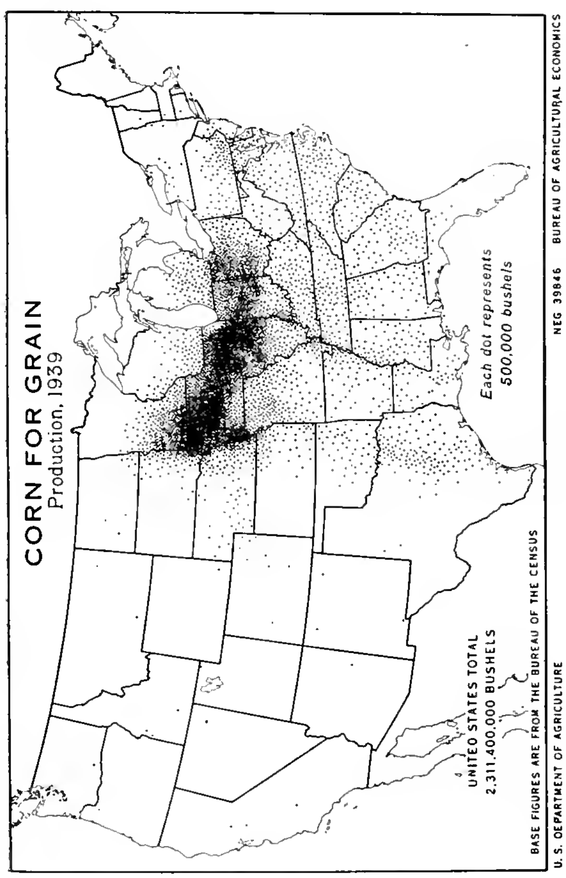


FIGURE 26

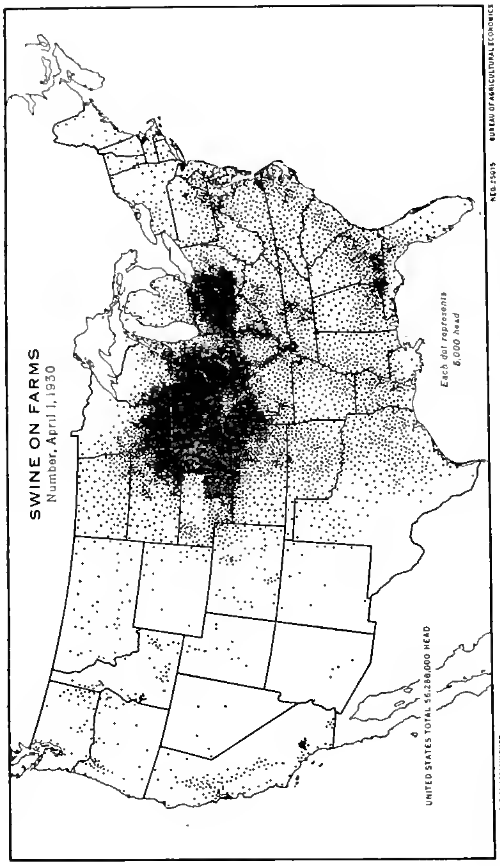


FIGURE 27

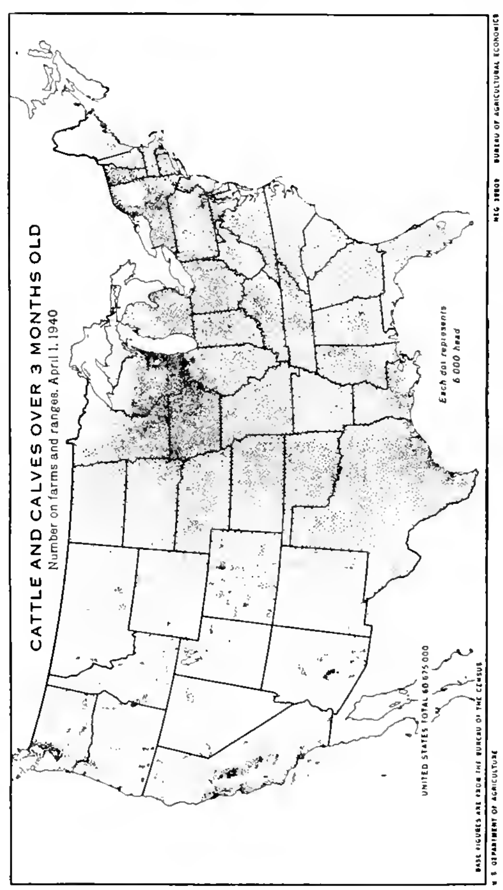


FIGURE 28

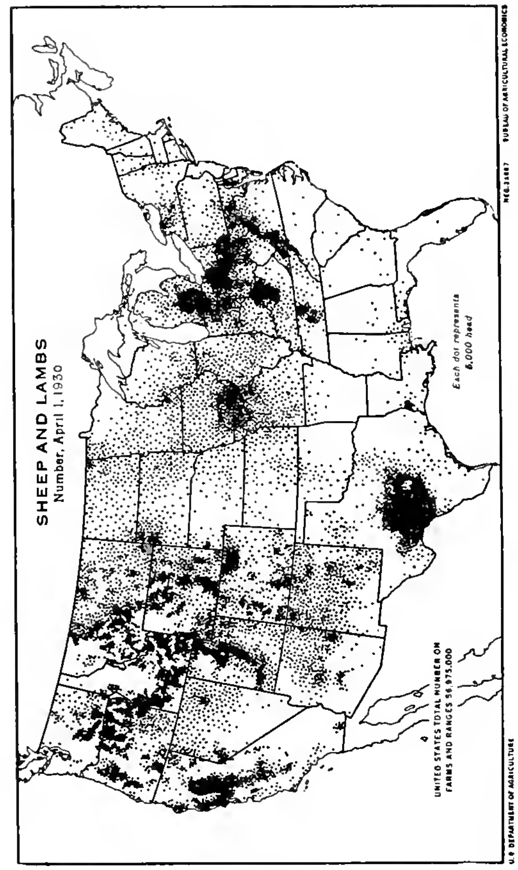


FIGURE 29

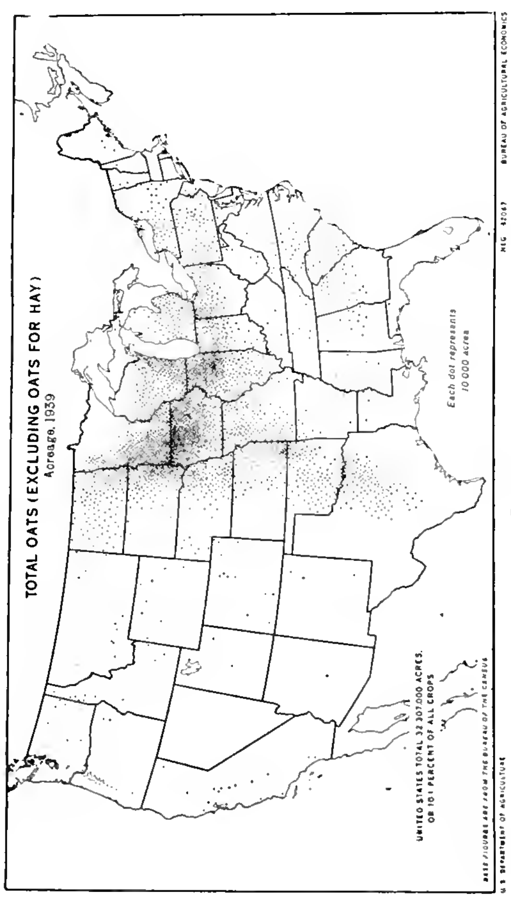


FIGURE 30

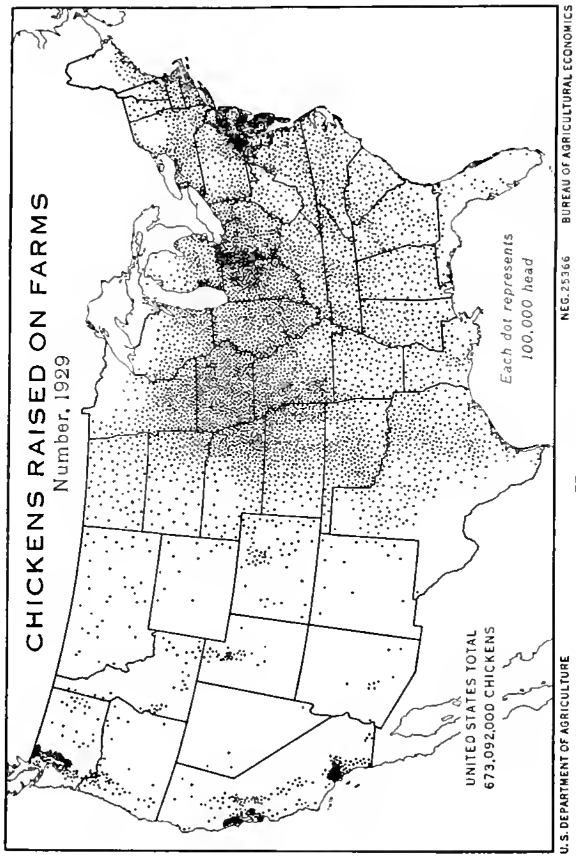


FIGURE 31

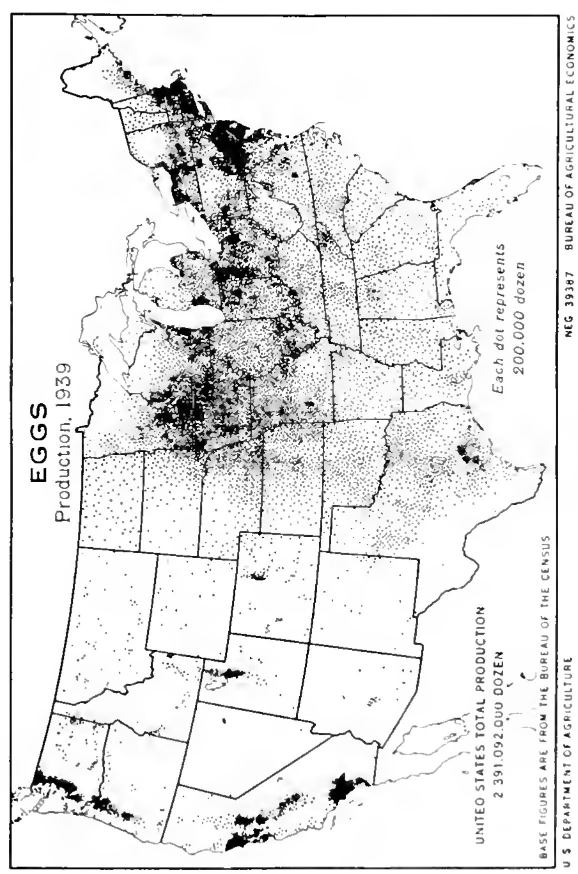


FIGURE 32

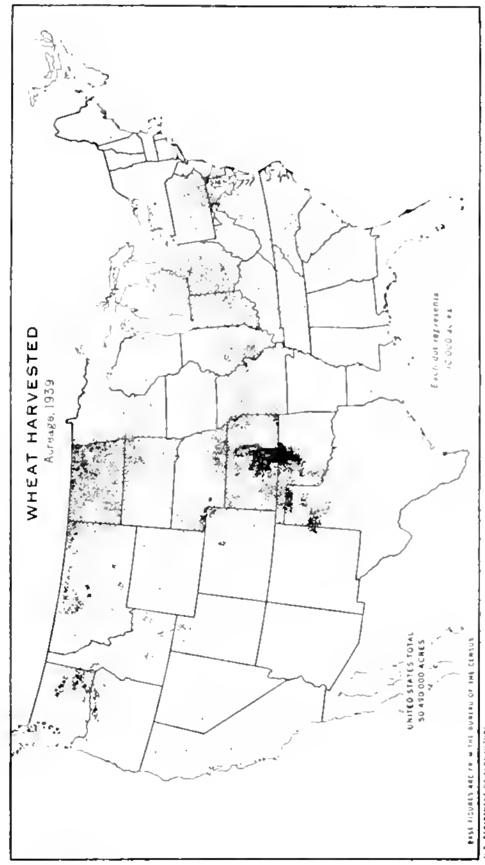


FIGURE 33

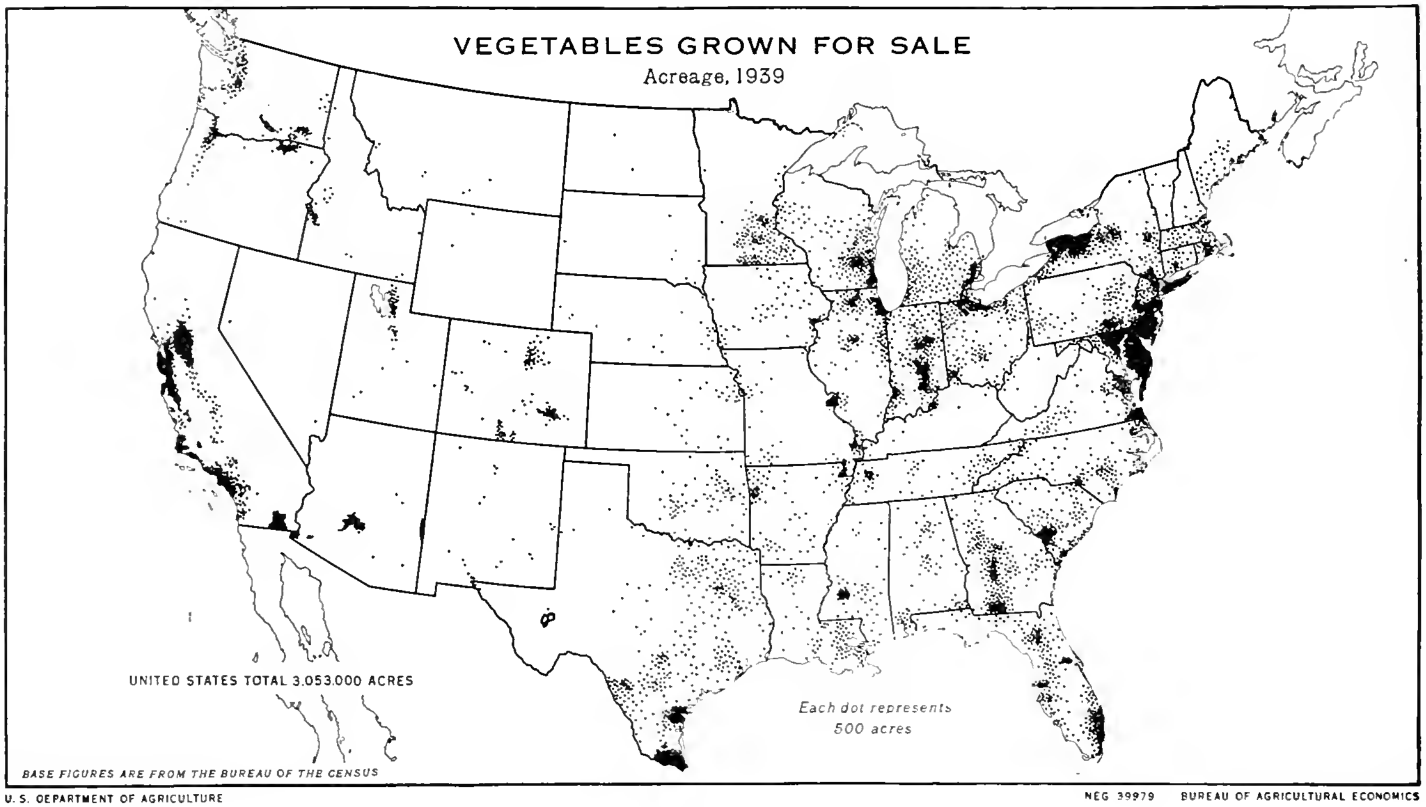


FIGURE 34

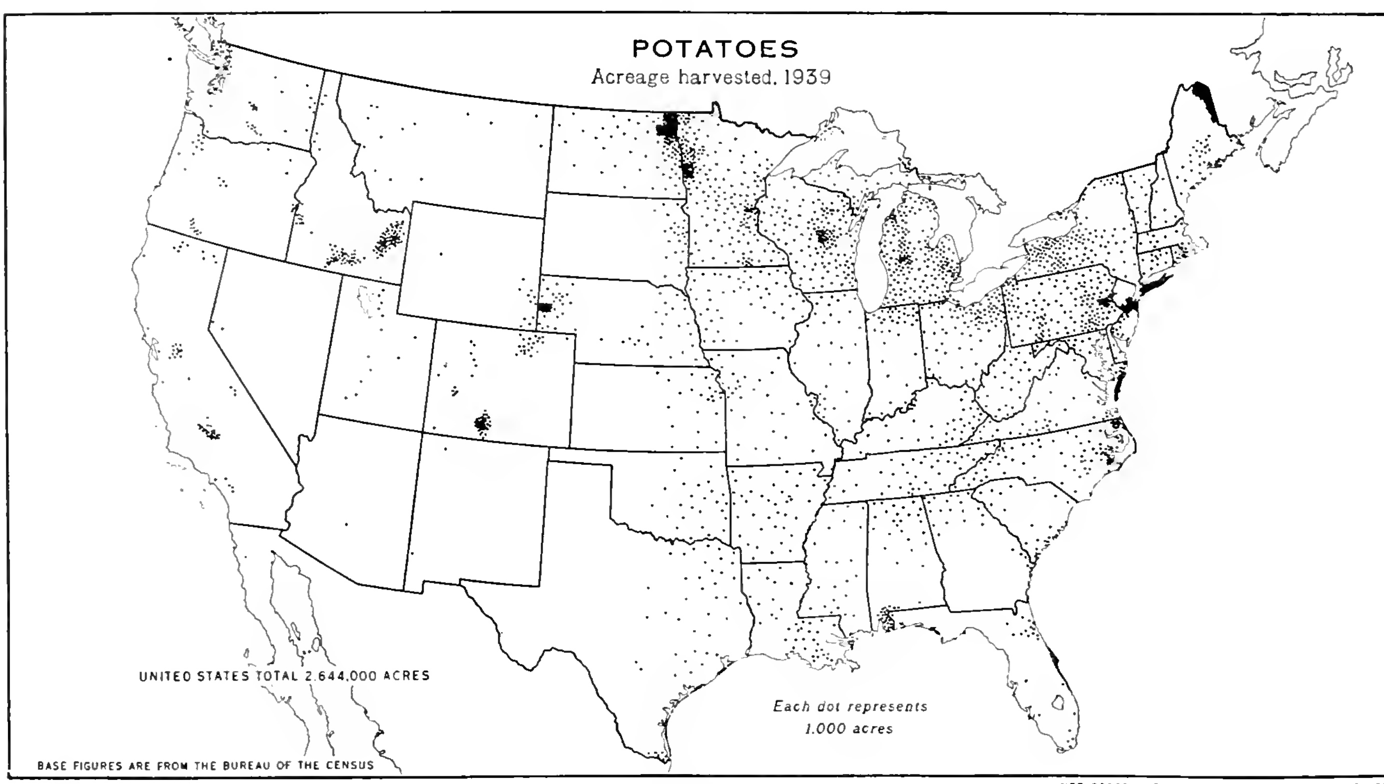


FIGURE 35

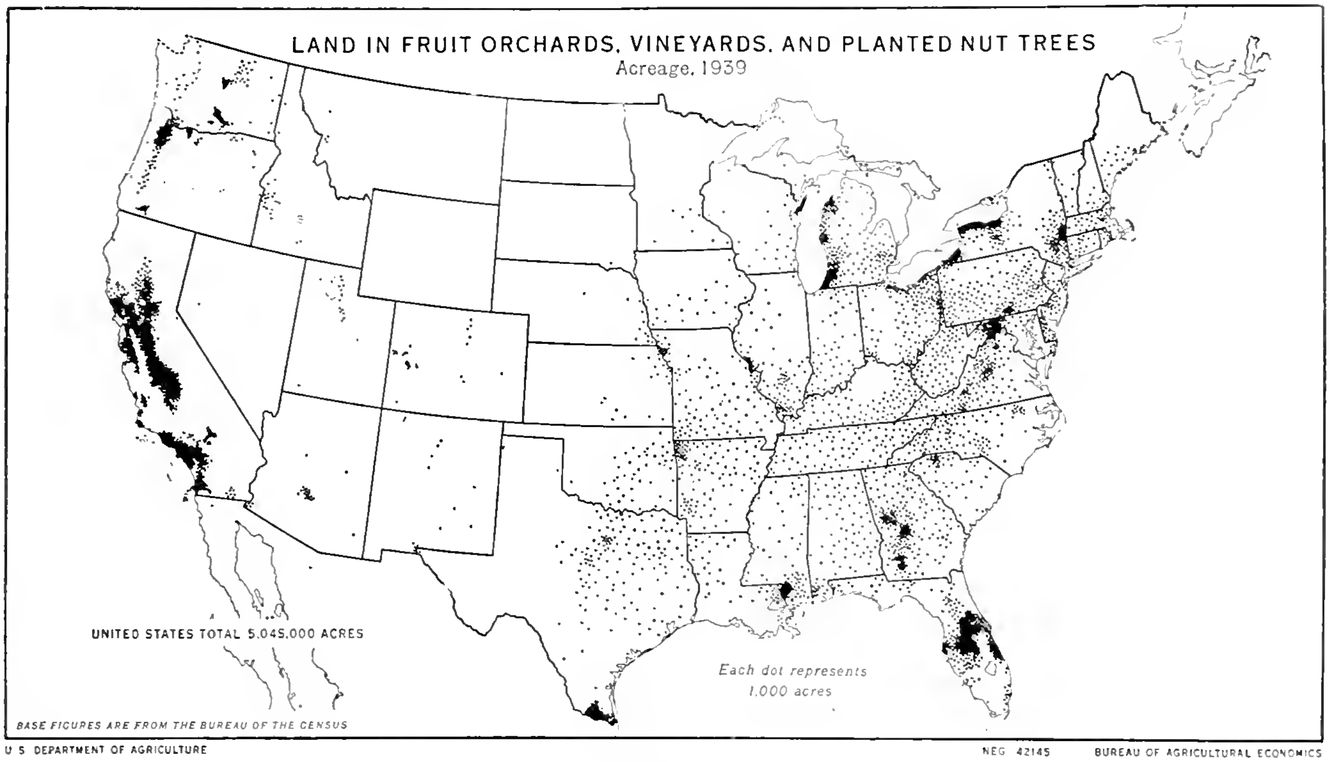


FIGURE 36

necessarily be at the expense of grazing in still drier areas, or at the expense of livestock and general farming within the present major area, or at the expense of corn and general farming in the more easterly areas, as the Corn Belt and Corn and Winter Wheat Belt. In any case, with our production varying sharply from year to year in accordance with plantings and weather conditions, but generally providing a sizable surplus for the now-crowded export market, it seems unlikely that expansion will be called for in the production of this bread grain.

Processing for the most part takes place eastward of the point of production, en route to the consuming centers of industrial population.

Truck Garden Areas

Small areas around major metropolitan agglomerations and larger areas, mostly near the Atlantic and Gulf coasts, and some irrigated sections of the Southwest, are given over to the intensive commercial production of vegetable crops (figs. 34 and 35).

Location factors closely related to particular areas include light rich soils, long growing season, plenty of moisture and climatic conditions favorable to an early seasonal start for one or more of the numerous crops. An additional factor usually of much importance is the comparative nearness of large industrial markets. The Imperial Valley of California, with its sunshine, irrigation water, and mild climate, presents in contrast conditions which enable growers there to serve the markets of even the eastern seaboard, especially in the winter season.

Subtropical Crop Areas

Coincident in location with some of the truck areas are the subtropical fruit areas (fig. 36). The Subtropical Fruit and Crop Belt divides into a humid type, which is almost of mild monsoon climatic type, and a California type requiring, generally, irrigation. These areas have poured onto the industrial markets, in fresh and more recently in processed forms, vast amounts of citrus fruits. There has been an upward trend in production, but roughly 60 percent of the approximately 80 million boxes of oranges come from the California sector, with most of the remainder from Florida. Slightly more than half of the 40 million boxes of grapefruit come from Florida and most of the remainder from Texas. Lemons are Californian, and limes Floridian.[14] Apparently the amount which might be produced of these fruits is limited more by the market than by nature; the Lower Rio Grande and Lower Mississippi Delta areas recently have risen to positions of some signifi-

[14] *The Fruit Situation*, U. S. Department of Agriculture, Bureau of Agricultural Economics, January 1941.

cance but not predominance. Otherwise, a variety of fruits, vegetables, and truck crops are the secondary products of these areas.

Grazing and Irrigated Crops Region

The grazing of livestock is the primary agricultural activity on very nearly one-half of the area of the United States, mostly in the West. The intensity of usage differs greatly from one part to another of the area but on the whole is an extensive rather than intensive industry, not nearly so intensive as in the Corn Belt, for example, either for animals per square mile or for total animals. Of all land grazed in the United States, about 11 percent is classed as plowable, 32 percent as woodland, and 57 percent as open land not tillable.[15] On the other hand, smaller areas within this larger grazing area of the intermountain region are irrigated and farmed intensively, either to provide a winter feed base for sheep and cattle grazed on open range during the warmer part of the year, or to produce such commercial crops as potatoes and sugar beets. Possibilities of expanding the food producing activities of this region appear to lie in the directions of better range management, a very moderate increase in the additional reclamation through irrigation, and, in some places, the more efficient use of water now under priority.

Fish

Fishing, in terms of either value of product or men employed, is roughly only one-hundredth as important as agriculture (table 1). The resources are largely peripheral. Fertilizer, oil, shell, and leather obtained from marine resources are of some industrial significance. The yearly catch, excluding that of Alaska, is about 3½ billion pounds (table 5), with a primary value of only $80,000,000 but a wholesale value of nearly $200,000,000. More than 4,000 vessels, with a tonnage of about 100,000, are regularly manned by 120,000 fishermen. Additional thousands are engaged in processing the catch. The nature, extent, and exploitability of the fish resources is much more difficult to evaluate than are the plant and animal resources of the land, not only because of the lack of an adequate census but equally because of uncertainty as to what areas or portions of the continental shelf may be in the future exploited in deep-sea fishing and to what extent the exploitation of any given area will be shared with others.

Innumerable rivers, streams, lakes, and ponds produce fish and mussels largely on a sport or noncommercial part-time basis with the product immediately utilized. The Lakes States area produces about two-thirds of the fisheries products of the interior, largely fresh-water fish used fresh or smoked for food, rather than shellfish. Most of this catch, valued at about $6,000,000, is in the upper Lakes area and has in recent years shown a general decline in quantity, particularly of the more delectable species, such as sturgeon, whitefish, and lake trout. Most of the catch is made overnight in gill nets or on set lines tended in power-driven boats.

The rivers of the interior formerly were productive of large amounts of food fish, especially the buffalo, the cat, and the carp types. Water pollution and overfishing have greatly reduced this part of the industry. It amounts to less than $3,000,000 per year, though employing more than twice as many fishermen as the Lakes States area.

New England shore, inshore, and deep-sea fisheries are well developed. The deep-sea fisheries employ most of the total of 665 boats, with total tonnage in excess of 22,500, and the greater part of more than 20,000 New England fishermen. The product, valued at about $18,000,000 in a recent year, consisted of both pelagic species (surface feeders) and demersal species

[15] *Agricultural Land Requirements and Resources*, p. 30.

TABLE 5.—*Fisheries of the United States and Alaska, 1938*

	Fishermen	Fishing vessels	Products	
			Weight	Value
			Pounds	
New England States	20,248	665 (22,528)	631,520,000	$18,275,000 (6,261,000)
Middle Atlantic States	7,549	409 (7,871)	216,858,000	8,249,000 (4,422,000)
Chesapeake Bay States	15,297	341 (7,388)	294,594,000	6,663,000 (4,073,000)
South Atlantic and Gulf States	29,588	1,115 (13,347)	621,858,000	13,074,000 (7,252,000)
Pacific Coast States	23,635	1,345 (40,578)	1,525,885,000	26,086,000 (2,099,000)
Lakes States	6,976	469 (6,022)	81,524,000	6,083,000 (7,000)
Mississippi River and tributaries[1]	15,884		82,383,000	2,897,000 (640,000)
Alaska	11,007	835 (11,781)	798,823,000	12,220,000 (159,000)
Total	130,184	5,179 (109,515)	4,253,445,000	93,547,000 (24,913,000)

Source: Department of the Interior, Fish and Wildlife Service.

[1] Data for 1931.

Figures in parenthesis under "Fishing Vessels" indicate tonnage thereof; the figures in parenthesis under "Value" are for shellfish.

(bottom feeders). Pelagic species include outstandingly the mackerel (most valuable of the pelagic species in this area), the herring (sold fresh, canned as sardines, and pressed for oil), and the menhaden (for fertilizer). Since these species are migratory, the fishing must follow the schools, and is seasonal. Though sailing vessels are still used, the operations are increasingly carried on with engine power.

Demersal species, on the other hand, migrate less freely, are exploited more on a year-round basis, and are caught mostly on lines or by trawl net on bottoms of not more than 200 fathoms depth. Cod, haddock, and halibut are the chief species. New England fishermen work mostly the Georges, Browns, and Sable Banks off Cape Cod, and to a much lesser extent the larger and more northerly Grand Banks. Fishermen from the United States take only about 10 percent of the cod caught off the east coast of North America. Of the total haddock taken in a recent year, amounting to 175,000,000 pounds, approximately 126,000,000 pounds were taken by United States fishermen, 102,000,000 pounds from the banks and 24,000,000 from inshore fisheries.

The shellfish of New England accounted for one-third the total value of the fisheries product in a recent year. The main components are the lobster, clam, and oyster. The oyster take for the area amounted to 11,400,000 pounds for one recent year. The primary fish markets are Boston and Gloucester, Mass., and Portland, Maine, where the fish are sold fresh, for immediate consumption in nearby dense centers of population, or are processed for shipping inland.

The fisheries of the Middle Atlantic, Chesapeake Bay, South Atlantic, and Gulf States are largely confined to the shore or near-shore areas. The grand total of fisheries of this long coast outranks the better-known New England industry, having two and one-half times as many men employed, three times as many fishing vessels, and a product, in terms of poundage and value, nearly twice as large. The menhaden species (used for oil and fertilizer) and mackerel are especially important. In terms of value, half the catch is shellfish, with the oyster, shrimp, and crab occupying the more important positions. The oyster harvest in a recent year amounted to 140,000,000 pounds and, though more is heard of the Chesapeake Bay oyster, the industry was rather well distributed over all major sectors of those coasts. These shellfish products are marketed inland as well as coastwise and several species lead to important processing and canning industries.

In terms of poundage the Pacific Coast States are the most productive section, with California accounting for more than one-third of the poundage catch for all of our fisheries, excluding Alaska. The more southerly west coast area provides several pelagic mackerellike species, especially the tuna, bonito, and yellowtail, mostly taken with rod and line, and processed for canning. Also belonging to the west coast area is the sardine, anchovy, and pilchard, which serve not only as human food (canned, salted, fresh) but also for oil and fertilizer. The chief demersal species taken is the halibut, mostly on hand lines, and in the more northerly sections above California. This product is iced and shipped inland for human consumption. As has been indicated earlier, full information on fisheries resources and reserves is not available. Enough is available, however, to indicate a serious decline, particularly in fresh-water fish and certain shore and inshore salt-water species. The conservation of fresh-water fisheries has been attempted by laws to control stream pollution, laws governing the methods and time of fishing, and the size and the number of fish legally allowed.[16]

Of the 4.3 billion pounds catch of commercial fish in 1937 (Alaska included) 2.1 billion pounds are classed as nonfood industrial material having a byproduct value of 37 million dollars. Derived therefrom in that year were nearly 300 million pounds of marine animal oils valued at 16 million dollars, shell products worth 11 million dollars, meal and scrap at 7 million dollars, and the remainder mostly credited to glue. The oils were largely used for soap (64 percent); additional significant uses were for paints (9 percent), shortening

TABLE 6. *Fish catch by States, 1938*

State	Weight (thousands of pounds)	Value (thousands of dollars)	State	Weight (thousands of pounds)	Value (thousands of dollars)
Alabama	12, 739	482	Nebraska	145	16
Arkansas	15, 733	411	New Hampshire	796	109
California	1, 294, 526	17, 055	New Jersey	108, 095	2, 908
Connecticut	11, 838	1, 420	New York	93, 593	5, 402
Delaware	17, 507	144	North Carolina	198, 765	1, 950
Florida	241, 443	4, 988	Ohio	22, 225	1, 510
Georgia	19, 835	381	Oklahoma	40	4
Illinois	15, 418	524	Oregon	71, 728	2, 400
Indiana	8, 481	223	Pennsylvania	2, 713	272
Iowa	7, 778	302	Rhode Island	13, 829	1, 056
Kansas	455	17	South Carolina	7, 911	274
Kentucky	1, 622	61	South Dakota	114	11
Louisiana	125, 096	4, 386	Tennessee	3, 435	104
Maine	67, 207	2, 521	Texas	24, 983	1, 042
Maryland	57, 263	2, 260	Virginia	237, 331	4, 403
Massachusetts	537, 850	13, 169	Washington	159, 631	6, 632
Michigan	28, 838	2, 265	Wisconsin	18, 120	1, 393
Minnesota	11, 701	429	Alaska	798, 823	12, 220
Mississippi	16, 910	726			
Missouri	928	77	Total	4, 253, 445	93, 547

The 1938 catch by chief varieties (thousands of pounds) was: Cod, 140,545; haddock, 169,044; herring (sea), 202,829; mackerel, 123,137; menhaden, 485,474; pilchard or sardine, 1,110,401; salmon (blueback, red, or sockeye), 245,094; salmon (humpback or pink), 235,976; shrimp, 143,101.

SOURCE: Department of the Interior, Fish and Wildlife Service.

[16] See *Report of the Acting Commissioner of Fisheries*, Bureau of Fisheries, U. S. Department of the Interior, Washington, 1940.

(7 percent), linoleum (6 percent), and miscellaneous (14 percent).[17]

That our fishing industry does not supply all of our fish needs is indicated by imports for 1940 valued in excess of 30 million dollars, with fresh-water fish and cod-liver oil as two of the more important items. Efforts are being made to provide substitutes from the shark, tuna, and sardine to meet the cod-liver oil deficit.[18] In the same year we exported nearly 18 million dollars of fish and fish products, predominantly canned salmon.[19]

Fibers, Furs, and Hides

To a much greater degree than is true of food resources, the United States is a deficit area for fibers, furs, and hides, with cotton a major exception. However, industrial raw materials of these sorts, having a market value to the producer of close to 1 billion dollars, were produced in the United States in 1940. Production is concentrated in a few types and areas, and reserve resources are also concentrated largely in the same areas.

Cotton

In terms of production volume and value, production facilities, extent of use, and related social and economic problems, cotton is our most significant industrial fiber resource. The production facilities for this fiber are localized in the so-called Cotton Belt of the Southern States (fig. 37). There, 1,640,025 farms[20] are so predominantly occupied in cotton production as to be classified as cotton farms; that is, 40 or more percent of the total production of those farms in terms of value is cotton (lint and seed). In all, 2,000,000 farms in the South and Southwest, on which live 10,000,000 persons, produce some cotton.[21] This figure includes most of the Southern farms found outside the mountainous areas and very nearly one-third of the farms of the Nation. Employed thereon are a majority of the rural negro families, primarily engaged in the production or initial processing (ginning) and handling to market of this most important fiber. Marketing and processing of cotton supports 500,000 persons, and cotton textile manufacturing furnishes a livelihood for an additional 3,000,000.[22]

The Cotton Belt includes approximately 240,000,000 acres[23] or more than one-tenth the area of the United States; of that area, 220,000,000 acres are classed as agricultural and a little less than three-fifths, or 152,600,000 acres, is actually included in farms. Of the farm acreage, 74,400,000 are classed as croplands. Cotton farms, a small number of which, under the Census definition, lie beyond the delimited margin of the Cotton Belt, included, as of 1930, 118,500,000 acres.[24] It is indicated that approximately 25,073,000 acres were planted to cotton in 1940, and of that, 24,078,000 acres[25] were actually harvested. Texas alone accounted for one-third of the acreage and nearly one-third of the yield. In short, only approximately one-tenth of the gross area of the Cotton Belt is now used to produce cotton and only one-third of the cropland thereof was in 1940 a producer of fiber for industry, domestic or foreign.

This present low acreage figure should be compared with the 33,166,000 acres of harvested cotton as an average for the period 1929–38, inclusive, the latter figure not including an average of 94,000 acres for the southern California area. Production for the year 1940 totaled 12,686,000 bales of lint (478 pounds per bale), valued at $573,400,000[26] cash to the farmer. This crop, while somewhat larger than that of the previous year, is more properly to be compared with the 13,547,000 bales average yield for the period 1929–38. The large crop is being produced on a considerably smaller acreage. The average yield per acre for 1940 was 252.4 pounds and the average yield since 1936 has been well above 200 pounds whereas the average for the 1929–38 period was 198 pounds. The now generally higher levels of yield are only partly creditable to weather factors; heavier fertilization, better selection and preparation of the land, and better care of the crop are apparently significant contributory factors.

The Cotton Belt is bounded, approximately, on the dry western margin by the mean annual precipitation isopleth of 22 inches and on the north by mean summer temperature of 77° F. and an average frostless season of 200 days.[27] Thus the gross area appears to be limited unless new species are developed for new areas; but,

[17] R. T. Whiteleather, "The Significance of Byproducts to the Fishery Industry," *Fishery Market News*, Vol. 1, No. 8, August 1939, pp. 3–5.

[18] *Industrial Bulletin*, No. 168, April 1941, Arthur D. Little, Inc., Cambridge, Mass.

[19] *Monthly Summary of Foreign Commerce of the United States*, December 1940, pp. 6 and 21.

[20] *Fifteenth Census of the United States: 1930, Agriculture*, vol. III, "Type of Farm."

[21] I. W. Duggan and Paul W. Chapman, *Round the World With Cotton*, U. S. Department of Agriculture, Agricultural Adjustment Administration, Washington, 1941, p. 3.

[22] *Ibid.*

[23] *Agricultural Land Requirements and Resources*, sec. IV, p. 30, table XXVI.

[24] *Fifteenth Census of the United States, loc. cit.*

[25] *General Crop Report*, U. S. Department of Agriculture, Washington, December 1940, p. 81.

[26] Preliminary figure from *Cash Farm Income and Government Payments in 1940*, U. S. Department of Agriculture, Bureau of Agricultural Economics, February 19, 1941, p. 6.

[27] V. C. Finch and O. E. Baker, *op. cit.*, p. 53.

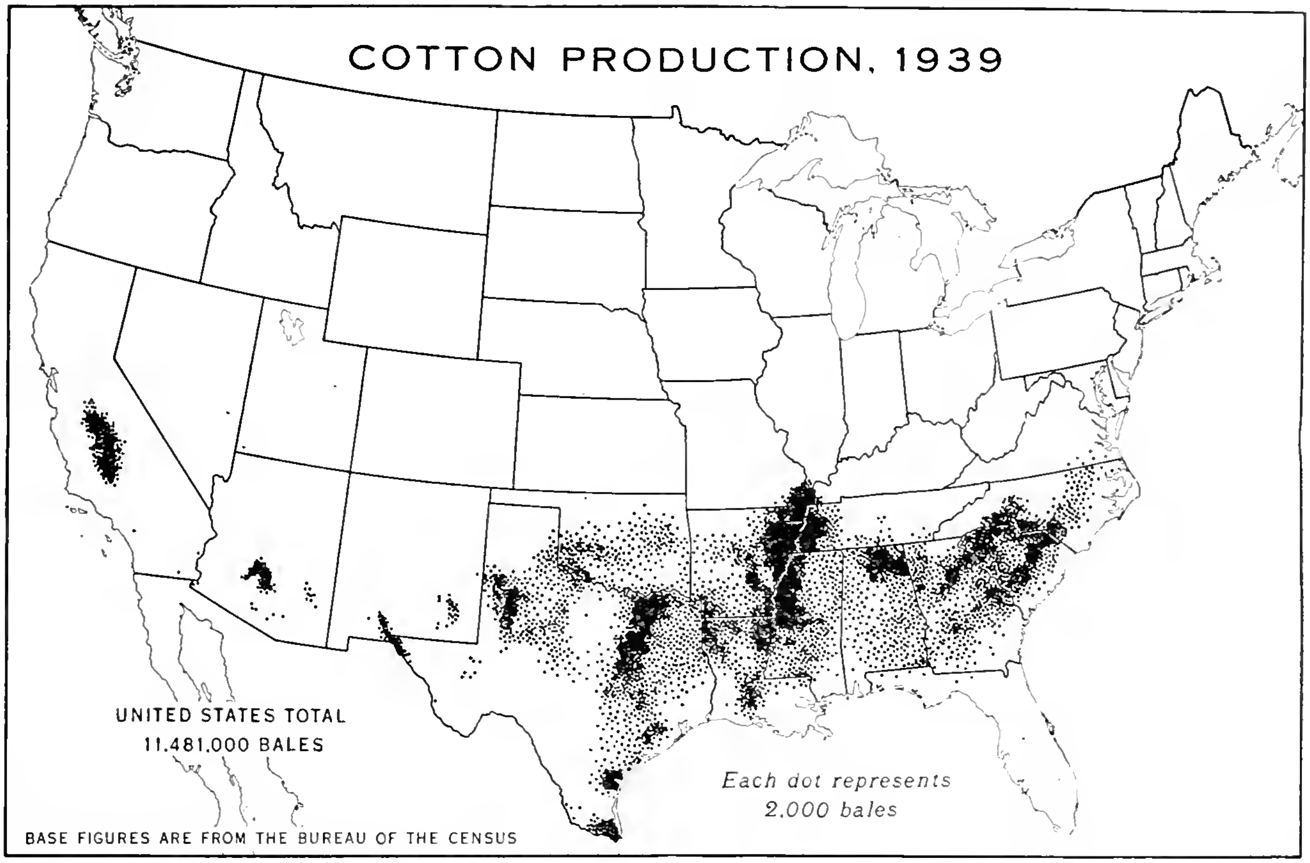


FIGURE 37

apparently, cotton production could be substantially expanded on acreage in the Cotton Belt, especially since parts of the acreage formerly devoted to cotton has been recently devoted to legumes and pasture, a practice that should improve the soil for cotton production. It should be noted that in one year during the 1929–38 period the harvested acreage of cotton stood at 43,232,000,[28] a figure which would allow an 80-percent increase in the 1940 harvested acreage.

An important byproduct of cotton-lint production is cottonseed, which is commonly estimated by allowing 65 pounds of seed for each 35 pounds of lint; cottonseed production in 1940 is estimated at 5,645,000 tons and is valued at $86,434,000.[29] The greater part of the cottonseed crop was crushed for oil, resulting in 1,272,733,000 pounds [30] of cottonseed oil, a considerable portion of which is edible oil.

In considering potential industrial supplies of cotton lint, and resources whereby future requirements may be met, it is significant that our productive capacity is basically geared to supplying not only a large domestic market but also a large foreign market. That is, the problem of the present and near future is not how to get enough cotton but how to use effectively unused surplus supplies, unused acres formerly devoted to cotton, and unemployed or ineffectively employed persons formerly employed in cotton production.[31] Whereas our exports during the crop year 1940 (beginning September 1) are estimated at not more than 1,000,000 bales and domestic consumption at at least 9,000,000 bales and possibly more, the period 1929–38 is indicated as having yearly exports averaging 6,325,000 bales and domestic consumption averaging 5,877,000 bales.[32] The carry-over of United States cotton at the first of the 1940 season was 12,600,000 bales—a full year's crop. Thus it would appear that supplies

[28] M. R. Cooper, *Statistics on Cotton and Related Data*, U. S. Department of Agriculture, Bureau of Agricultural Economics, Washington 1939, p. 1.

[29] Preliminary figure from *Cash Farm Income and Government Payments in 1940*, U. S. Department of Agriculture, Bureau of Agricultural Economics, February 19, 1941, p. 6.

[30] *The Fats and Oils Situation*, U. S. Department of Agriculture, Bureau of Agricultural Economics, February 1941, p. 10.

[31] See O. C. Stine, "Future of Cotton in the South," *Journal of Farm Economics*, vol. XXIII, No. 1, February 1941, pp. 112–120. pp. 112–120.

[32] *The Cotton Situation*, U. S. Department of Agriculture, Bureau of Agricultural Economics, Washington, February 1941, p. 14.

are normally abundantly available to meet any probable requirements in the United States even without expanding acreage. Imports of cotton lint into the United States have been largely to furnish types not available domestically in sufficient amounts and in 1938–39 stood at 157,000 bales.[33] The use of cotton linters and the possible use of cotton lint as a source of cellulose will be discussed briefly in a later section.

Other Vegetable Fibers

In contrast with the surfeit of cotton fiber available, the United States usually is a deficit area in respect to other vegetable fibers. The 3,228,000 acres devoted to flax in 1940 were for linseed production, not for linen fiber. The resulting byproduct flax plant fiber, produced under conditions of comparatively dry climate and with entire lack of emphasis on fiber quality, is coarse and brittle, suited at best only for spinning into coarse twine or for use, as some other straws are used, in the manufacture of commercial strawboards. Meanwhile, during the same year, 1940, the imports of flax, unmanufactured and manufactured, plus minor but unspecified amounts of hemp and ramie, were valued at $22,139,000.[34] Of that amount the unmanufactured flax was valued at $1,175,000. The production of flax for fiber has been given some recent attention in the more humid portions of the country, particularly with reference to substituting for cotton lands in the South.[35] If efficient machinery can be developed for separating the usable fiber, thus eliminating the costly hand labor now required, eastern and southern sections may raise enough flax to replace a considerable part of the imports. Apparently, a significant part of the irrigated acreage of Peru formerly devoted to long-staple cotton is being diverted to flax, and that fiber has already been contracted for in the United States of America.[36]

Vegetable fibers other than cotton and flax, mostly unmanufactured, were imported amounting to $24,817,000 in 1940. Chief among these were sisal, or henequin, which is used largely as the fiber of twine for grain binding. Imports, mostly from Yucatan and the East Indies, regularly amounting to more than 100,000 tons, in 1940 were valued at nearly half of the above total. Manila, or abaca, constitutes a strategic defense material because of its resistance to salt water, floating ability, strength, and elasticity. Imports, largely from the Philippines, were valued in 1940 at $5,497,000. Jute and jute butts from India amounting to 38,000 tons were imported in 1938;[37] imports of this material, raw and manufactured, in 1940 were valued at $57,234,000.[38] Most jute is used to manufacture the coarse fabric called burlap, of which 50,000,000 yards were used per month. Hemp was once produced for fiber in our Midwest and recently has been slightly revived there, particularly in southeastern Wisconsin.[39] Kapok, a tree cotton from southern Asia and the East Indies, is classed as a critical material in defense and is otherwise of moderate importance. Though the United States does not duplicate within its borders the natural and economic conditions required for the commercial production of all of these fibers, such fibers, natural or artificial, as we do produce may in some cases be substituted.

Wool

At present we produce only about one-half of our wool requirements and are not likely to expand greatly the present production. Something like 48,500,000 sheep in 1940 contributed 388 million pounds of wool, valued at $110,000,000—an average of 8 pounds per fleece and 28.4 cents per pound to the farmer.[40] In addition, something like 62,000,000 pounds of pulled wool were produced. The distribution of production is similar to that shown for sheep in figure 29, a distribution which is highly spotted, with two-thirds of the total in the western half of the country. Expansion of production is unlikely inasmuch as the more arid lands of the western half of the country, where range sheep are little subject to disease and may be raised more easily than most domestic animals, are already occupied; the eastern concentrations are on farm holdings and must compete with other domestic animals and crops.

Domestic production is not sufficient to supply the domestic demand for certain types of wool. Imports of unmanufactured wool into the United States in 1940 were 357,193,262 pounds, valued at $83,026,891, with Argentina the leading source. In the rather unusual year for which figures are shown above, nearly two-thirds of the imports were of apparel wools, largely

[33] M. R. Cooper, *op. cit.*, p. 23A.

[34] *Monthly Summary of Foreign Commerce of the United States*, December 1940, p. 24.

[35] "Flax May Be Cotton Kingdom's Ally," *Business Week*, October 12, 1940, pp. 54–55.

[36] A cable under date of March 26, 1941, from Lima, Peru, to the New York Times, reports that the National Research Council's conducted tour found that 700 acres were planted experimentally to flax in 1939, 2,800 in 1940, and 22,000 acres the present year. This latter figure should be compared with the 140,000 acres normally devoted to cotton, the crop now being displaced. The cable further reports that not only has the 1941 crop been sold at 42 cents per pound for flax fiber and 20 cents per pound for the shorter tow, but that the 1942 crop has been purchased under forward contract.

[37] *Agricultural Statistics*, 1941, p. 497.

[38] *Monthly Summary of Foreign Commerce of the United States*, December 1940, p. 25

[39] "Hemp a Money Maker For Wisconsin Farmers," *The Prairie Farmer*, October 5, 1940, p. 5.

[40] *The Wool Situation*. U. S. Department of Agriculture, Bureau of Agricultural Economics, March 1941, p. 12, table 1.

of fine quality, with the remainder confined mostly to carpet wools from many sources.[41] Wool manufactures imported in 1940 were valued at $18,733,636 and were allocated about one-half to fabrics, one-fifth to wearing apparel and the remainder to carpets and rugs.[42] Exports of wool manufactures of several types during 1940 were valued at nearly $6,000,000, whereas exported semimanufactured wool material, mostly rags, noils, and waste, had a value of $7,500,000 for 31,500,000 pounds.[43]

Mohair and Related Materials

Approximately 4 million angora goats in the United States, sheared twice yearly of their mohair fleece, produce nearly 19 million pounds of this long elastic fiber. Production is more than 80 percent from Texas, mostly in the rough, dry Edwards Plateau area. Production elsewhere in the United States is in areas of somewhat the same terrain, or where the goats are used for their brush-clearing qualities, as in the Ozarks.[44] This amount apparently very nearly satisfied industrial needs, for whereas 250,000 pounds of mohair were imported, manufactured mohair of total weight 166,000 pounds was exported. At the same time alpaca, cashmere, and camel fibers, which to some extent are competitors of mohair, were imported in excess of 3 million pounds and valued at nearly $1,500,000.[45]

Hair, some of it human hair, but predominantly horse hair, was imported in 1940 in amounts having a value of more than $4,600,000.[46] Though our hatters and felters have imported yearly as much as 8 million pounds of rabbit fur for felting, rapid progress is being made in the substitution of chemicals for part of the hair product.[47] Nearly 10 million pounds of feathers valued at about $3,000,000, were imported in 1940;[48] the amount of domestic production is unknown.

Furs

The annual market value of raw pelts in the United States is roughly $60,000,000, of which about one-sixth is produced by commercial fur farms. Practically every farm, forest, and wood lot is a potential source of fur. Though the paucity of data does not allow an estimate of the general over-all significance of the fur catch to States or the country at large, it has recently been declared: "Louisiana ranks as the leading fur-producing State in the country. There are approximately 12,000 trappers in Louisiana alone. Their activities give employment to some 30,000 persons."[49] Furs move largely as raw skins to a few central markets, of which St. Louis is by far the largest. After the auction sales there, and possibly some initial processing, the furs move to the manufacturing markets, largely in and near New York City.

Wildlife has been unable to meet the requirements of the fur-manufacturing industry in the face of overtrapping, natural depletion by fire, flood, drought, disease, and encroaching civilization, together with greatly increased middle-class consumption of fur products. This inability is indicated by the rapid development of fur farming. That industry, which is estimated as having an investment value in excess of $50,000,000 with an annual product of one-fifth of that amount, is still growing rapidly.[50] The *Census of Agriculture* reports 2,750 farms keeping silver fox in captivity; 2,655 such farms reported 103,301 females on hand as of April 1940; 2,444 farms reported 261,070 pelts taken in 1939. Mink were kept by 2,836 farms of which 2,754 reported 161,457 females on hand in April 1940, and 2,027 farms reported 291,324 pelts taken in 1939. Further evidence that domestic demand exceeds domestic supply is presented in tables 7 and 8. Imports of raw fur material, in which rabbit and lamb were especially large items, were nearly eight times as large in value as the exports, mostly manufactured items.

Hides and Skins

This industrial raw material, from which is processed leather and its industrial derivatives, is the most significant byproduct of animal slaughter—predominantly of cattle. Though the production pattern corresponds roughly to the distribution patterns of the several animal types mostly used (figs. 28 and 29), the industry is predominantly located between the point of production and the meat-consuming industrial areas. Inasmuch as this industrial resource is a byproduct, worth normally not more than one-tenth of the total value of the animal, hides are available only because animals are produced for other reasons. We can discuss available resources in terms of normal

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[41] *Ibid.*, table III.

[42] *Monthly Summary of the Foreign Commerce of the United States*, December 1940, p. 25.

[43] *Ibid.*, p. 10.

[44] Statistics from *Agricultural Statistics*, 1940, U. S. Department of Agriculture, Washington, 1940, p. 411.

[45] *Monthly Summary of the Foreign Commerce of the United States*, December 1940, p. 25.

[46] *Ibid.*

[47] "Hats Made With Milk," *Business Week*, October 12, 1940, p. 55.

[48] *Monthly Summary of the Foreign Commerce of the United States*, December 1940, p. 22.

[49] National Resources Planning Board, "Preliminary Statement, Regional Development Plan, South Central Region," *Development of Resources and Stabilization of Employment in the United States*, Washington, January 1941, p. 206.

[50] "The Silver Fox," *Fortune*, vol. XIV, No. 6, December, 1936, pp. 125–127. More exact data will be available from the 1940 census, the first to include fur farming.

slaughter, and potential resources in terms of existing domestic animals of the types providing desired hides and their rate of reproduction.

As of January 1941 nearly 200,000,000 animals on our farms were potential sources of hides of greater or lesser worth.[51] Of that number nearly 72,000,000 were cattle, 56,000,000 were sheep or lambs, and the remainder consisted of horses, mules, and swine. It is estimated for a recent year that the slaughter of hogs was 66 million, of sheep and lambs nearly 22 million, and of cattle and calves, about 23 million.[52] Thus the ratio between number slaughtered during the year, and year-end stocks on farms, is approximately 1 to 1 in the case of swine, 1 to 2½ for sheep and lambs, and 1 to 3 plus for cattle and calves. This is a crude way of saying that our existing reserves in the case of cattle are at best only a normal 3-year supply, and of

[51] *Crops and Markets*, vol. 18, No. 2, February 1941, p. 25.
[52] *Agricultural Statistics*, 1940, pp. 359, 375, and 400.

TABLE 7.—*Imports of fur merchandise for consumption, by articles, 1940*

	Quantity (numbers except as noted)	Value
Furs and fur manufactures	----------	$79,811,240
Furs, undressed [1] (except silver fox)	----------	73,661,564
Badger	42,301	69,546
Beaver	114,791	1,936,112
Caracul	7,235	39,694
Coney and rabbit	[1] 24,641,429	11,664,670
Ermine	859,047	693,228
Fitch	514,309	960,087
Fox except silver	1,331,156	4,800,381
Guanaquito	152,812	219,543
Hare	7,541,002	1,463,137
Kolinski	709,458	1,290,861
Lamb, kid, sheep, and goat skin furs	11,721,069	32,421,883
Marmot	839,981	1,304,103
Marten	141,170	2,049,294
Mink	1,032,210	4,744,403
Mole	244,974	13,583
Muskrat	1,976,829	2,070,044
Nutria	155,780	398,312
Opossum	890,541	393,163
Otter	36,233	217,679
Pony	103,250	243,117
Raccoon	77,399	140,990
Sable	4,105	324,942
Skunk	179,971	245,800
Squirrel	4,229,773	2,015,072
Weasel	2,275,353	1,948,587
Wolf	92,455	409,135
Jackal, leopard, lynx, ocelot, and wildcat	309,508	1,306,465
All other	----------	277,733
Fur skins, dressed [2] (including raw silver fox)	----------	2,336,090
Coney and rabbit	26,433	7,227
Dog and goat	214,461	212,931
Hare	42,530	13,331
Caracul, lamb, and sheep	103,187	488,497
Other dressed furs	----------	211,663
Silver fox, dressed or raw	76,857	1,402,441
Fur cut for hatters' use [2]	[3] 9,846	11,464
Plates, mats, etc. [2]	----------	3,609,630
Hats, caps, and bonnets of fur or of fur felt:		
For men and boys [2]	52,111	109,487
For women and girls [2]	12,268	17,483
Other manufactures [2]	----------	65,522

[1] Duty free. [2] Dutiable [3] Pounds.

SOURCE: *Monthly Summary of the Foreign Commerce of the United States*, December 1940. Corrected to January 31, 1941, p. 22.

TABLE 8.—*Exports of domestic fur merchandise, by articles, 1940*

	Number	Value
Furs and manufactures	----------	$11,411,545
Undressed furs:		
Civet cat	80,717	35,146
Fox:		
Silver and black	2,032	30,914
Red	86,770	320,752
Other	39,722	114,817
Muskrat, northern	2,175,057	2,412,253
Muskrat, southern	5,345,246	3,389,337
Raccoon	406,322	581,939
Skunk	410,867	415,608
Opossum	2,367,458	805,756
Mink	79,552	456,103
Other undressed furs	1,313,711	1,312,001
Dressed or dyed:		
Fox, silver and black	1,710	34,675
Muskrat	9,396	12,435
Fur-seal	1,537	33,745
Other dressed or dyed furs	308,796	676,149
Fur wearing apparel (except fur-felt bats)	7,328	161,547
Fur waste, fur pieces, and damaged fur skins	----------	455,315
Other fur manufactures	----------	163,053

SOURCE: *Monthly Summary of the Foreign Commerce of the United States*, December 1940. Corrected to January 31, 1941, p. 7.

the others less. Horses and mules, of course, are used as workstock, and the hide when taken at all is likely to be from an animal 10 or more years of age.

The meat-packing industry, which accounts for the greater part of the slaughter of cattle, hogs, and sheep, reports for 1937 that the total production, through those channels, of cattle and calf hides amounted to 707,787,000 pounds, valued at $97,066,000.[53] Of those totals, calf skins represented 11 percent of the poundage and 16 percent of the value. The report on sheep indicated 14,932,000 sheep and lamb pelts valued at $26,074,000 plus 31,127,000 pounds of pickled sheep and lamb skins valued at $6,570,000. Other hides and skins, excepting furs, were comparatively insignificant and valued at only $180,000.

In spite of this seemingly large supply, the records reveal that the supply falls well short of the demand. During 1940, imports of raw hides and skins, excepting furs, amounted to more than 362 million pounds valued in excess of $50,000,000. Wet salted cattle hides and dry or dry salted goat and kid skins accounted for more than $30,000,000[54] of that total. In addition to these raw materials, leather and leather manufactures to a value of more than $9,000,000 were imported. On the other hand, all raw hides and skins (excepting furs) exported, together with exports of leather and leather manufactures from the United States in that year amounted to only approximately $25,000,000.

Lumber and Other Wood Products

Lumber for homes and farmsteads, timbers for mines, ties for railroads, fuel for heating, pulp for

[53] *Statistical Abstract of the United States*, 1939, p. 665.
[54] *Monthly Summary of the Foreign Commerce of the United States*, December 1940, pp. 6, 7, 21, and 22.

newspapers and magazines, and viscose for rayon are derived from our forest resources. More than 2,000,000 men are dependent for employment on the forests, as itemized in table 9.[55] Inasmuch as most forest products are bulky in relation to value, it may reasonably be expected that the pattern of primary processing will closely resemble the pattern of harvest of forest resources. Generally, the resource pattern has been a highly favorable one. Not only have the more populous and industrialized areas during periods of rapid development had the advantage of propinquity to the supply of lumber, pulp, and firewood, but such products as were available for export (naval stores, lumber, ships) were relatively near the ocean transportation. But the present pattern of stand is hardly so favorable as that of even a few decades ago, and some trends that may be discerned are not wholly reassuring.

Forest Land Resource Patterns

Unlike the basic pattern of agricultural food resources, which are ubiquitous but nevertheless intensified toward the interior of the country, the outstanding feature of our forest land resources is that they occupy predominantly the outer portions of our country. (See fig. 38, and table 10.) The 21 States which touch the oceans or the Gulf contain only 36.2 percent of the area of the United States, but include 49.3 percent of the forest land (table 10). To include with this group all the States which touch Canada would change the ratio only slightly. This marginal position of our forest land was perhaps even more a predominant characteristic of the pattern prior to the time when the eastern and southern stands were largely cut. The peripheral pattern is partially accounted for by the climate of the midland plains area, which is apparently more favorable to grass than to trees. The high fertility of the soil of much of the wooded portion of the eastern interior plains stimulated the early clearing of forest so that crops might be grown; whereas the rugged mountainous areas nearer the margins of the continent were not only forest-covered originally but were also less likely to be denuded for agricultural use.

As a measure of forest resources, the total forest area, or even the area classified as commercial forest land, is a very rough index. For most industrial purposes information as to millions of board-feet of saw-timber as well as a breakdown into hardwood, softwood, particular species, rate of cut, rate of total depletion, and rate of restocking may be more useful.

[55] That the total from table 9 is a minimum estimate is suggested by comparison with another estimate, of approximately 3.75 million man-years directly and indirectly employed in 1936.

TABLE 9.—*Employment dependent on forests*

Manufacturing industry [1]	1935		
	Proprietors and firm members	Salaried personnel	Wage earners
Rayon and allied products [2]	----------	2,741	38,418
Billiard and pool tables, bowling alleys, etc	8	50	314
Boxes, cigar	37	192	3,176
Boxes, wooden, except cigar	279	2,023	23,061
Caskets, coffins, etc	227	2,347	13,779
Cooperage	150	790	9,879
Excelsior	41	77	831
Furniture, including store fixture	1,481	16,393	130,781
Matches	2	420	5,075
Lumber and lumber products not elsewhere classified	5,413	13,612	255,230
Mirror and picture frames	91	522	2,677
Planing mill products	1,411	9,078	48,297
Synthetic resins, etc	28	1,590	12,749
Turpentine and rosin	938	1,104	27,248
Window and door screens	86	458	1,873
Wood preserving	6	848	8,985
Wood turned and shaped, etc	445	2,308	21,522
Pulp, wood, and other fiber	1	2,071	23,627
Paper	8	11,689	103,344
Converted paper products	552	17,432	108,694
Wood distillation and charcoal	7	506	3,808
Total, manufacturing industries	940,830		

	1935	
	Proprietors and firm members	Salaried personnel and wage earners
Distribution:		
Wholesale lumber	1,818	41,482
Wholesale paper	1,659	32,491
Retail lumber	10,798	90,256
Total, distribution industries	178,504	

	1930
Fabrication:	
Cabinet makers	57,897
Carpenters	929,426
Total, fabrication industries	987,323
Miscellaneous:	
Foresters and forest rangers, State and Federal (1938 estimate)	9,954
Pattern and model makers (1930)	29,750
Trade associations, inspectors, etc. (estimate)	5,000
Railroad transportation (estimate)	29,900
Total, miscellaneous employment	74,604
Grand total, employment dependent on forests	2,181,261

[1] For more complete industry description see the *Census of Manufactures, 1935*.
[2] It has been estimated that the rayon industry depends upon the forests for 76 percent of its raw material. The figures given represent 76 percent of the employment shown in the *Census of Manufactures*.

SOURCE: Adapted from *Forest Lands of the United States*, Hearings before the Joint Committee on Forestry, 76th Cong., 3rd sess., on S. Con. Res. 31 (75th Cong.) and H. Con. Res. 11 and 23 (76th Cong.), concurrent resolutions to establish a Joint Committee on Forestry, part 8, General Hearings, Washington, D. C., January 16 and 20 and February 16, 1940, p. 1751.

Nearly one-third of the total area of the United States is forest land. Approximately one-fourth of the area of the United States is commercial forest land. Of the 844,510,000 acres [56] of total area not included in farms more than one-half, or 444,683,000 acres, are in forest and nearly 73 percent of this nonfarm forest area is classed as commercial. Three-fourths of the

[56] *Sixteenth Census of the United States: 1940.*

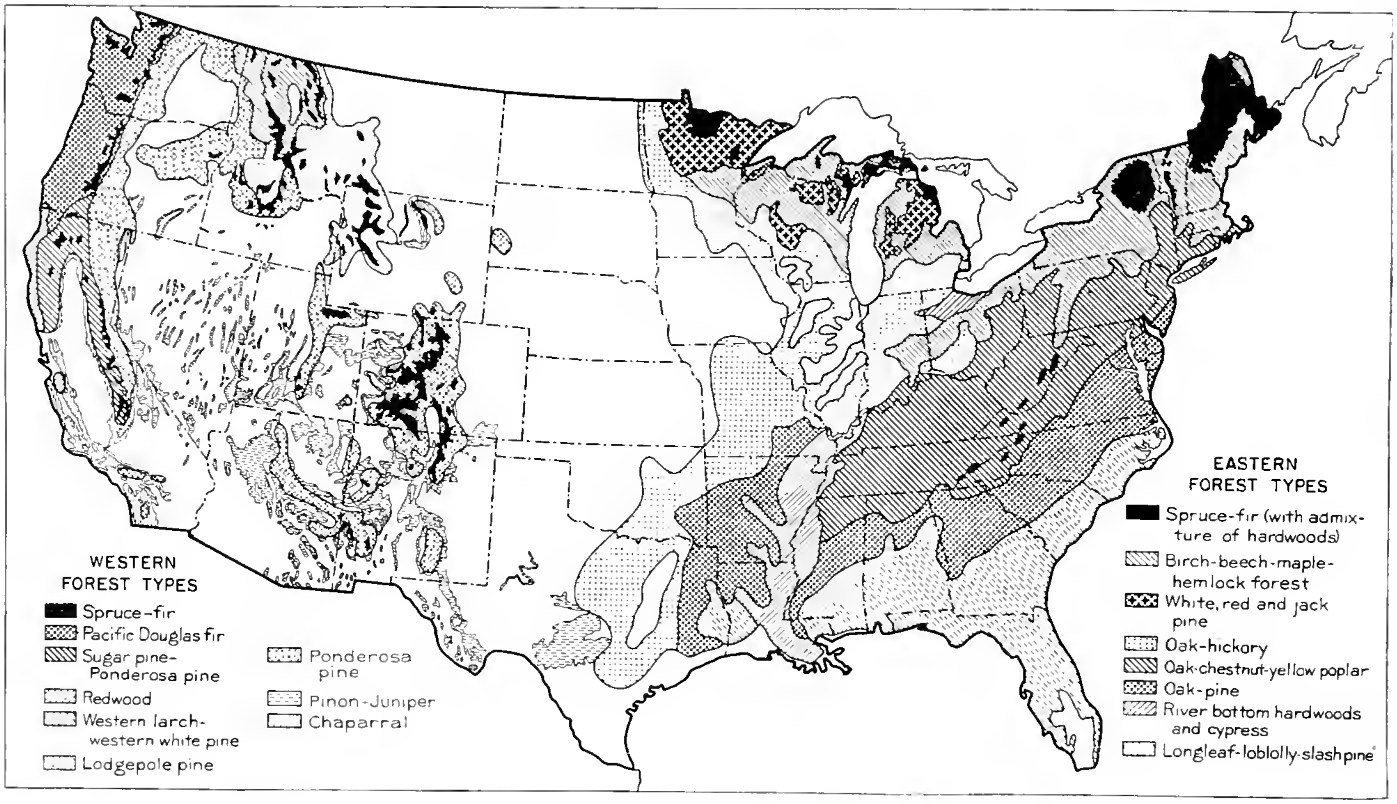


FIGURE 38.—Principal Forest Types of the United States

185,500,000 acres of farm woodland is also classed as commercial. (See table 11.) This would seem to be a fact of some significance not only from the standpoint of farm employment and income but also for its probable bearing upon opportunities for decentralization of some types of industry.

It is a well-known fact that much of the commercial forest area is multiple-use area involving not only timber production but also watershed protection, recreation, wildlife support, and grazing. For example it has been indicated that 249,000,000 acres of forest not in farms is used also for grazing purposes.[57] In all, 223,668,000 acres of the commercial forest land is grazed. Noncommercial forests occupy 168,461,000 acres and of that area very nearly 120,000,000 acres are grazed.

Saw Timber

Of the total commercial forest area, somewhat less than half is classed as saw-timber area; the latest estimate indicates nearly 213,000,000 acres so classified (table 12). Of the saw-timber acreage a little less than half is old growth. In the Columbia River Basin, in California, and the South Rocky Mountain areas, old growth still occupies a much larger acreage than second-growth saw timber. Elsewhere, excepting the Lake States, where the two are nearly even, the predominant acreage is second-growth.

The saw-timber stand indicated is 1,763,651,000,000 board feet to which is added each year by growth 32,033,000,000 board feet and against which an annual depletion of 47,808,000,000 is charged, thus giving a net yearly depletion of 15,775,000,000 board feet. Examination of table 13 reveals significant variation as to the density of saw-timber stand per unit of saw-timber area. The Columbia River Basin and California with around 20,000 board feet per acre of saw-timber area are at one extreme whereas the central area with only 1,500 board feet per acre of saw-timber area is the other extreme. Depletion varies sharply from region to region, not only as to total, which is heavy in the Columbia River Basin and the south, but in relation to growth. In the northeastern area depletion of saw timber is now so low as apparently to be offset by growth. Elsewhere depletion exceeds growth. The variations from area to area as to the quantitative abundance of saw-timber resources suggest that saw-timber areas near present heavily industrialized sections of the country are relatively poor, with the exception of the Pacific Coast in respect to softwoods.

[57] National Resources Board, *Report* * * *, December 1934, p. 109, table 2.

Table 10.—*Commercial and noncommercial forest areas, by States*

[Thousands of acres]

State	Total land area	Commercial forest land [1]	Total forest land	Percent of total land area classed as commercial forest land
Alabama	32, 819	18, 837	18, 877	57
Arizona	72, 838	3, 607	19, 629	5
Arkansas	33, 616	20, 669	20, 913	62
California	99, 617	13, 655	48, 159	14
Colorado	66, 341	12, 516	20, 431	19
Connecticut	3, 085	1, 636	1, 648	53
Delaware	1, 258	325	325	26
Florida	35, 111	21, 852	23, 561	62
Georgia	37, 584	21, 035	21, 432	56
Idaho	53, 347	15, 215	25, 095	29
Illinois	35, 868	3, 196	3, 217	9
Indiana	23, 069	3, 438	3, 471	15
Iowa	35, 575	2, 358	2, 382	7
Kansas	52, 335	--------	1, 251	0
Kentucky	25, 716	9, 408	9, 482	37
Louisiana	29, 062	16, 185	16, 211	56
Maine	19, 133	14, 933	14, 956	78
Maryland	6, 402	2, 386	2, 387	37
Massachusetts	5, 145	3, 001	3, 004	58
Michigan	36, 787	18, 679	19, 073	51
Minnesota	51, 749	17, 244	19, 615	33
Mississippi	29, 672	15, 859	15, 873	53
Missouri	43, 985	15, 588	15, 596	35
Montana	93, 524	14, 613	20, 687	16
Nebraska	49, 157	--------	970	0
Nevada	70, 285	377	8, 655	1
New Hampshire	5, 780	4, 575	4, 608	79
New Jersey	4, 809	2, 000	2, 013	42
New Mexico	78, 402	4, 018	20, 066	5
New York	30, 499	11, 539	14, 179	38
North Carolina	31, 194	18, 161	18, 588	58
North Dakota	44, 917	--------	587	0
Ohio	26, 074	4, 651	4, 662	18
Oklahoma	44, 396	4, 224	11, 771	10
Oregon	61, 188	24, 452	29, 662	40
Pennsylvania	28, 692	15, 278	15, 312	53
Rhode Island	683	361	367	53
South Carolina	19, 517	10, 706	10, 732	55
South Dakota	49, 194	1, 213	1, 733	3
Tennessee	26, 680	12, 555	12, 821	47
Texas	167, 963	10, 806	26, 657	6
Utah	52, 598	3, 348	24, 215	6
Vermont	5, 839	3, 342	3, 349	57
Virginia	25, 768	13, 375	13, 608	52
Washington	42, 775	19, 562	24, 070	46
West Virginia	15, 374	8, 859	8, 961	58
Wisconsin	35, 364	16, 472	16, 946	47
Wyoming	62, 431	5, 588	8, 350	9
Total	1, 903, 217	461, 697	630, 158	24

Source: U. S. Forest Service.

[1] Land capable of producing timber of commercial quantity and quality, and available now or prospectively for commercial use.

Table 11.—*Ownership of forest land in the continental United States, exclusive of Alaska*

Ownership class	Total	Commercial	Noncommercial
	Million acres	*Million acres*	*Million acres*
Private:			
Farm woodland	185. 5	138. 8	46. 7
Industrial and other	248. 3	202. 1	46. 2
Total	433. 8	340. 9	92. 9
Public:			
Community	7. 8	7. 1	. 7
State	19. 0	16. 9	2. 1
Indian reservations	12. 0	6. 4	5. 6
National parks and monuments	6. 5	--------	6. 5
Public domain	24. 0	4. 7	19. 3
National forests	122. 0	81. 5	40. 5
Other Federal	5. 0	4. 2	. 8
Total	196. 3	120. 8	75. 5
All classes	630. 1	461. 7	168. 4

Source: R. E. Marsh and W. H. Gibbons, "Forest Resource Conservation" table 3, p. 467, *Yearbook of Agriculture, 1940*, Washington, 1941. Also, *Forest Lands of The United States*, p. 20, Senate Document 32, 77th Congress, Washington, 1941.

If the picture of our forest reserves is to be more realistic, attention must be directed to species (figure 38), to age, and to economic and geographic factors involved in the problem of the supply and demand. One authority has recently summarized the situation:

> * * * the bulk of our wood is consumed as saw timber. From it are obtained lumber, veneer, cross ties, and much of our pulpwood. The volume of our remaining saw timber is 1,764 million board feet. Three-fourths of this is old growth. But because of poor quality, inferior species, remoteness, etc., probably not over two-thirds of all saw timber is economically available under present market conditions.
>
> In 1936 the total drain through cutting and losses on our combined forest capital of saw-timber and cordwood-size material exceeded growth by 2.2 billion cubic feet. The drain on saw timber alone, estimated at 47.8 billion board feet, exceeded total saw-timber growth by 15.8 billion board feet, or 50 percent. But because of poor quality and poor species and remote location, not all growth really counts. So drain exceeded effective growth by an additional 4.5 billion board feet. The relation between saw-timber drain and growth is still less favorable because drain includes more high-quality material than growth does.[58]

Lumber

In 1936, 42,443,000,000 board feet of saw timber were cut for lumber, and other items as shown in table 14. The distribution of the lumber production by regions for 1938 is shown in table 15, amounting to a total of 21,646,000,000 board feet. That the softwoods are providing approximately six times as much lumber as the hardwoods is indicated therein. Also the outstanding positions of the west coast area and of the South as lumber producers is strongly indicated. It may be noted by reference to table 13 that the cut of saw timber much exceeds the rate of growth in the western area, but that the differential is not so great in the South.

When production of lumber is compared with consumption by regions (table 15) it is evident that the heavier industrial regions of the East and Middle portions of our country are deficit areas, using something like four times as much lumber as they produce. In the West, it is interesting to note that the South Pacific area with its increasing industrialization, is at least for the present a large deficit area.

That production and consumption even for a single State, depending as they do on species and many other factors, become far from a simple matter, is illustrated by the following:

> Consumption of lumber in California exceeds production in the State in the ratio of more than 5 to 3 (2,570,000,000 and 1,460,000,000 board feet annually respectively). Nevertheless,

[58] *Report of the Chief of the Forest Service, 1940*, U. S. Department of Agriculture, Forest Service, Washington, 1940, pp. 14–15.

TABLE 12.—*Commercial forest area of the United States, by character of growth and region, 1938*

Region	Total		Saw-timber areas [1]			Cordwood areas [2]	Fair to satisfactory restocking areas [3]	Poor to nonrestocking areas [4]
			Total	Old growth	Second growth			
	1,000 acres	*Percent*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*	*1,000 acres*
Northeastern [5]	59,376	13	21,154	8,002	13,152	15,361	14,702	8,159
Central [6]	29,231	6	9,680	367	9,313	8,660	5,204	5,687
Lake [7]	52,395	11	7,123	3,586	3,537	10,831	13,442	20,999
South [8]	202,531	44	96,694	25,128	71,566	47,961	29,114	28,762
Columbia River Basin [9]	73,842	16	44,106	37,206	6,900	11,967	8,523	9,246
California	13,655	3	11,417	8,653	2,764	148	155	1,935
South Rocky Mountain [10]	30,653	7	22,683	17,889	4,794	5,859	161	1,950
Plains [11]	14	(12)	5	1	4	4	6	
Total	461,697	100	212,862	100,832	112,030	100,791	71,306	76,738

[1] Includes areas characterized by timber large enough for sawlogs (lumber) in accordance with the practice of the region regardless of its actual use. Old-growth areas bear uncut or lightly cut stands of mature saw timber; second-growth areas support predominately immature saw timber which has come in following removal of the old timber by cutting or other causes. This means: For the South, at least 600 board feet per acre in trees 9 inches in diameter breast high and larger of pine and cypress and 13 inches and larger of hardwoods (of the 96,694 thousand acres of saw timber it is estimated 22 million acres bear less than 1,500 board feet per acre); Lake, 2,000 board feet per acre in both hardwood and softwood trees 9 inches and larger; Columbia River Basin, interior, 3,000 board feet per acre for pine and 4,000 board feet for fir trees 11 and 13 inches and larger, respectively, and for west coast, 5,000 board feet per acre in trees 15 inches and larger for softwoods.

[2] Cordwood areas bear stands characterized by timber too small for sawlog production but large enough for cordwood regardless of whether the stand is cut for this use or held for saw timber. Does not include noncommercial woodland even though subject to some cutting.

[3] Fair to satisfactory restocking areas include lands on which at least 40 percent of the growing space is fully occupied by commercial species predominately below cordwood size.

[4] Poor to nonrestocking areas include lands with less than 40 percent of the growing space fully occupied by commercial species predominately below cordwood size.

[5] New England and Middle Atlantic States combined, the area northeasterly from the Potomac River.

[6] Illinois, Indiana, Iowa, Missouri, and Ohio.

[7] Michigan, Minnesota, and Wisconsin.

[8] States south of the Ohio and Potomac Rivers, including Arkansas, Louisiana, and the easterly portions of Oklahoma and Texas.

[9] Idaho, Montana, Oregon, and Washington.

[10] Arizona, Colorado, Nevada, New Mexico, Utah, Wyoming, and 5 southwestern counties of South Dakota.

[11] North Dakota, South Dakota (except 5 southwestern counties). Nebraska, Kansas, and the westerly portions of Oklahoma and Texas.

[12] Less than 0.005 percent.

SOURCE: R. E. Marsh and W. H. Gibbons, *op. cit.*, table 2, p. 463.

TABLE 13.—*Saw-timber area, stand, growth, and depletion in the United States, 1938*

Region	Saw-timber area [1]	Saw-timber stand [2]	Annual saw-timber growth [3]	Annual saw-timber depletion	
				Cut [4]	Total
	Thousand acres	*Million feet board measure*	*Million feet board measure*	*Million feet board measure*	*Million feet board measure*
Northeastern	21,154	84,025	2,625	2,190	2,468
Central	9,680	14,301	978	1,770	1,781
Lakes	7,123	57,616	1,850	2,146	2,421
South	96,694	386,570	20,403	21,869	23,642
Columbia River Basin	44,106	882,632	5,247	12,084	14,263
California	11,417	213,480	414	1,919	2,650
South Rocky Mountains	22,683	124,992	516	466	583
Plains	5	35	(5)	(5)	(5)
Total	212,862	1,763,651	32,033	42,444	47,808

[1] Areas characterized by timber large enough for sawlogs (lumber) in accordance with the practice of the region, regardless of its actual use. Status, close of 1938.

[2] Includes trees large enough for lumber, cross ties, veneer, and similar sawed or sliced products, on commercial forest-land area, in accordance with the cutting practice of the region concerned. Status, close of 1938.

[3] Estimates on the basis of lumber tally, assuming bark excluded and utilization consistent with good practice in each region. As of 1938.

[4] Trees of saw-timber size, cut for lumber and other commodities. Based on data of 1936.

[5] Growth and depletion considered negligible.

NOTE—Regions are the same as in table 12.
Source: U. S. Forest Service.

we ship out of the State 40 percent of what we cut (587,000,000 board feet). Oregon and Washington ship us somewhat more than we cut within our own borders (1,500,000,000 board feet).[59]

Fuel Wood

In some areas wood is still an important fuel. This use of wood relieves to some extent the demands which would otherwise be put on mineral fuels and at the same time competes to some extent with industrial uses for the wood. Ideally, the production of fuel wood can be managed in such a way as to utilize weed species, to thin young stands, and utilize nonlumber parts of saw timber.

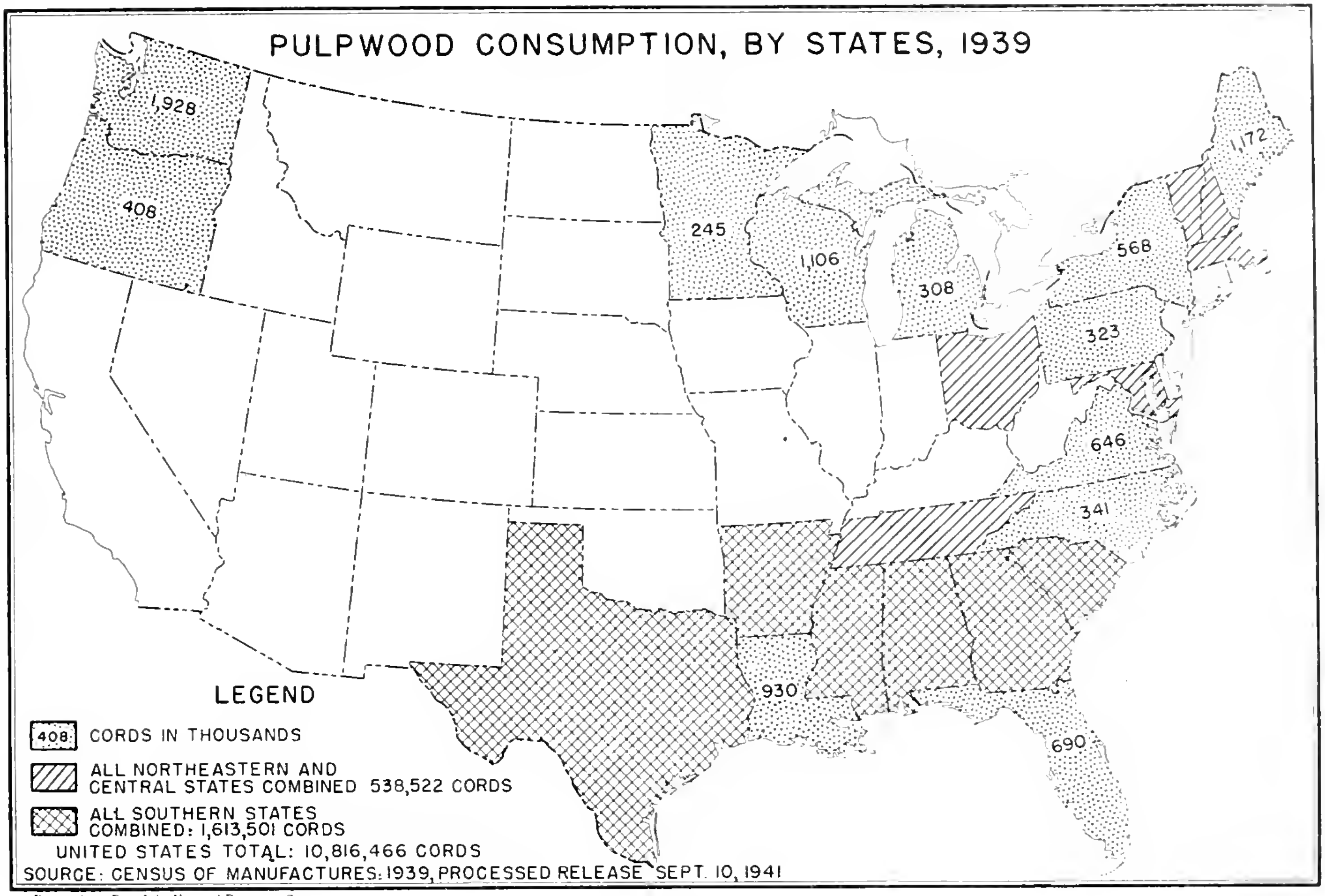
Of the 66,000,000 cords of fuel wood produced in 1936 approximately 70 percent constituted true drain on commercial forest; the remainder was largely salvage from logging operations. Much of the true drain was from cordwood trees rather than from saw-timber trees (table 14).

Pulpwood

The production of pulpwood, for its several rapidly growing industrial uses, has come to be, in terms of cubic feet of timber used, the third largest aspect of the forest industry. Of a pulpwood consumption in 1938 of 9,194,000 cords,[60] approximately 8,163,000 cords were produced domestically. Over half of this amount was derived from saw-timber trees and somewhat less than half from cordwood trees. The areas of consumption of such bulk wood material are indicated in figure 39. Wood pulp production, closely related to pulpwood consumption, amounted to 5,934,000 tons. Southern yellow pine has been an increasingly important type in pulp production and now accounts for more than one-third of the total, whereas the northern domestic spruce has declined from its earlier position of leadership. The southern area is one in which, because of climate and soil, these soft pulpable species grow in 20 to 30 years to a size adequate for harvest.

[59] *Forest Lands of the United States*, Hearings before the Joint Committee on Forestry, 76th Cong., 3d sess., Washington, 1940, p. 683.

[60] *Agricultural Statistics*, 1940, p. 680.



Prepared in office of the National Resources Committee

FIGURE 39

TABLE 14.—*Timber removed from commercial forests of the United States by cutting and by destructive agencies, 1936*

Item	All timber [1]			Saw-timber trees [2]			Cordwood trees [3]		
	Total	Softwood	Hardwood	Total	Softwood	Hardwood	Total	Softwood	Hardwood
TIMBER CUT FOR COMMODITIES									
	1,000 cu. ft.	*1,000 cu. ft.*	*1,000 cu. ft.*	*1,000 bd. ft.*	*1,000 bd. ft.*	*1,000 bd. ft.*	*Cords*	*Cords*	*Cords*
Lumber	5,367,585	3,997,846	1,369,739	27,702,415	22,016,083	5,686,332	218,422	150,908	67,514
Fuel wood	3,619,482	1,219,241	2,400,241	6,400,401	3,121,767	3,278,634	25,551,196	6,495,647	19,055,549
Pulpwood	705,924	638,026	67,898	2,252,147	2,107,802	144,345	2,519,165	2,196,496	322,669
Hewed ties	354,189	182,611	171,578	1,491,753	885,461	606,292	92,300	37,000	55,300
Fence posts	327,060	131,434	195,626	628,576	252,354	376,222	2,113,031	964,527	1,148,504
Veneer logs	252,443	71,472	180,971	1,190,415	412,733	777,682	7,747	181	7,566
Mine timbers (round)	161,016	47,264	113,752	151,102	77,693	73,409	1,147,749	272,921	874,828
Cooperage stock	149,447	61,169	88,278	704,346	333,603	370,743	7,010	......	7,010
Shingles	108,658	107,600	1,058	492,590	489,271	3,319	12,157	11,086	1,071
Other	354,203	153,379	200,824	1,429,629	710,516	719,113	543,258	159,950	383,308
Total	11,400,007	6,610,042	4,789,965	42,443,374	30,407,283	12,036,091	32,212,035	10,288,716	21,923,319
TIMBER REMOVED BY DESTRUCTIVE AGENCIES									
Fire	861,608	588,595	273,013	1,390,373	1,195,796	194,577	6,678,064	4,137,164	2,540,900
Insects, disease, etc.	1,201,141	861,706	339,435	3,973,930	3,570,783	403,147	4,801,810	2,079,911	2,721,899
Total	2,062,749	1,450,301	612,448	5,364,303	4,766,579	597,724	11,479,874	6,217,075	5,262,799
Aggregate total	13,462,756	8,060,343	5,402,413	47,807,677	35,173,862	12,633,815	43,691,909	16,505,791	27,186,118

[1] Includes saw-timber and cordwood trees. The volumes, necessarily shown in cubic feet, include the tops (cordwood size and larger) of the softwood saw-timber trees and the tops and limbs of the hardwood saw-timber trees. Bark is not included.

[2] Includes only timber of saw-timber size. The volumes, in board feet, are equivalent to the lumber which could have been sawed from such trees.

[3] Includes only the merchantable volume, in cords, of trees below saw-timber size, from saw-timber, cordwood, and restocking areas.

SOURCE: R. E. Marsh and W. H. Gibbons, *op. cit.*, table 8, p. 480.

TABLE 15.—*Relation of lumber production and consumption in the United States, by regions, 1938*

Region	Production				Consumption				Surplus production (+) or shortage (−)	Ratio consumption to production
	Total		Softwood	Hardwood	Total		Softwood	Hardwood		
	Million ft. b. m.	*Percent*	*Million ft. b. m.*	*Million ft. b. m.*	*Million ft. b. m.*	*Percent*	*Million ft. b. m.*	*Million ft. b. m.*	*Million ft. b. m.*	
New England	511	2.4	406	105	983	4.6	833	150	−472	1.92
Middle Atlantic	298	1.4	103	195	2,677	12.5	2,232	445	−2,379	8.98
Lake	775	3.6	317	458	1,770	8.3	1,364	406	−995	2.28
Central	863	4.0	160	703	3,494	16.3	2,496	998	−2,631	4.05
Prairie	37	.2	27	10	863	4.0	839	24	−826	23.32
Total	2,484	11.6	1,013	1,471	9,787	45.7	7,764	2,023	−7,303	3.94
South Atlantic	2,470	11.4	1,914	556	1,923	9.0	1,455	468	+547	.78
East Gulf	2,641	12.2	2,311	330	1,132	5.3	1,006	126	+1,509	.43
Lower Mississippi	4,247	19.6	3,279	968	2,642	12.4	2,186	456	+1,605	.62
Total	9,358	43.2	7,504	1,854	5,697	26.7	4,647	1,050	+3,661	.61
North Pacific	7,140	33.0	7,112	28	2,201	10.3	2,174	27	+4,939	.31
South Pacific	1,462	6.7	1,462	(1)	2,682	12.5	2,634	48	−1,220	1.83
North Rocky Mountain	792	3.6	792	(1)	400	1.9	397	3	+392	.50
South Rocky Mountain	410	1.9	410	(1)	615	2.9	611	4	−205	1.50
Total	9,804	45.2	9,776	28	5,898	27.6	5,816	82	+3,906	.60
All regions	21,646	100.0	18,293	3,353	21,382	100.0	18,227	3,155	+264	.99

[1] Less than 0.5 million board feet.

NOTE.—Lumber regions consist of the following States:
New England: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont.
Middle Atlantic: Delaware, District of Columbia, Maryland, New Jersey, New York, Pennsylvania.
Lake: Michigan, Minnesota, Wisconsin.
Central: Illinois, Indiana, Kentucky, Missouri, Ohio, Tennessee, West Virginia.
Prairie: Iowa, Kansas, Nebraska, North Dakota, South Dakota.
South Atlantic: North Carolina, South Carolina, Virginia.
East Gulf: Alabama, Florida, Georgia.
Lower Mississippi: Arkansas, Louisiana, Mississippi, Oklahoma, Texas.
North Pacific: Oregon, Washington.
South Pacific: California, Nevada.
North Rocky Mountain: Idaho, Montana.
South Rocky Mountain: Arizona, Colorado, New Mexico, Utah, Wyoming.

SOURCE: U. S. Forest Service, Division of Forest Economics.

Other advantages, including accessibility to market, suggest that the humid forest area of the South will take over a larger share of the burden of providing the pulp needs of industry.

Paper, one of the more necessary and useful items of our civilization, is little more than a felted sheet of wood fibers. Though straw and cotton are used to some extent as raw material, the 11,381,000 tons [61] of paper produced in the United States in 1938 was very largely produced (85 percent or more) from wood, processed by mechanical or chemical treatment. Paper and pulp constitute a large part of our wood imports, as indicated in table 16. Rayon, the most important of the synthetic fibers, is processed from cellulose. At present full capacity, the industry requires approximately 510,000,000 pounds of cellulose per year, 385,000,000 from wood pulp, and 125,000,000 from cotton linters. In 1940 the industry produced 471 million pounds of rayon yarn and staple fiber, against 379 million in 1939.[62] Though mineral fibers, nylon, vinyon, and fiberglas are not yet serious competitors, silk (wholly imported) accounted for $125,930,868 of the imports of raw materials and for $5,671,751 of those for manufactured production in 1940. Rayon and other synthetic textile imports in that year were valued at less than 5 million dollars. As to exports, rayon accounted for nearly $18,000,000 in 1940, whereas manufactured silks exported were valued at only $6,417,288.[63] Cellophane and other plastics use small amounts of cellulose at the present time, but this type of use is relatively new and may expand markedly in the future.

Imports and Exports of Wood

An indication of the complexity of the foreign trade of the United States in wood and wood materials is suggested by table 16. Also therein is revealed a so-called unfavorable balance of trade with imports exceeding exports by almost $100,000,000, the larger items of excess being paper manufactures and paper base stocks (almost wholly wood pulp and pulpwood).

Wood Reserves for the Future

The question of supplies for the future is complex, not alone from the standpoint of acres, stocks, and species, but also from the standpoint of how much forest materials will be needed. We use only one-fourth as much lumber per capita as in 1906, yet the forest now has to meet demands, particularly for pulp,

[61] *Ibid.*

[62] *Ibid.*, p. 131, and also "Synthetic Fibers," *The Index* (New York Trust Company), vol. XXI, No. 1, 1941, pp. 18 and 24.

[63] *Monthly Summary of the Foreign Commerce of the United States*, December, 1940, Washington, 1941, pp. 10, 25, and 26.

TABLE 16.—*Major items of wood export and import, 1940*

Article	Exports	Imports
Unmanufactured wood	$2, 603, 534	$8, 448, 599
Sawmill products	36, 781, 266	24, 177, 362
Wood manufactures	20, 745, 643	10, 699, 155
Cork and manufactures	1, 358, 594	6, 763, 249
Paper base stocks	32, 469, 519	75, 414, 452
Paper manufactures	66, 390, 491	132, 618, 140
Total	160, 349, 047	258, 120, 957

SOURCE: Adapted from *Monthly Summary of the Foreign Commerce of the United States*, December 1940, Washington, pp. 11 and 26.

which were almost unknown then. There is also the question of how long and how much we can depend on Canada and northwestern Europe for pulpwood and wood pulp.

The solution of the supply problem involves first the wider application of modern forestry to commercial forest lands, whether public or privately held, whether farm or nonfarm forest. One recent authoritative statement on the matter holds that to attain the objective of bringing timber yields and requirements into balance in 75 years would require the following procedures:

* * * an increase under intensive forestry of more than a million acres a year. It would mean a great expansion in the area under extensive forestry. The growing stock in the East would have to be built up to twice the present available stand. In the West the remaining timber would have to be carefully husbanded to facilitate the conversion of the western forests to a sustained-yield basis. * * * The safeguarding of existing stands in the East and their development into adequate growing stock is the most urgently needed measure. Generally speaking, a forest property upon which stands are already established, even though inadequately, can be developed into a regulated sustained-yield enterprise at less expense and more quickly than can one upon which stands are largely lacking.

This does not minimize the necessity of providing for an adequate planting program for areas not likely to restock naturally; for the development of adequate protection against fire, insects, and disease; and for the control of cutting in the western regions, to facilitate the conversion of those forests to an adequate sustained-yield basis.[64]

Organic Oils, Chemicals, and Miscellaneous Products

Vegetable oils are used not only for food, as indicated in table 1; they provide a significant raw material basis for several industries producing nonedible products. Nearly a third of the vegetable oils are used for inedible manufactures. The oils in this group differ widely among themselves—cottonseed oil is practically all used for food, palm oil for food and soap, linseed, tung, perilla, and castor oils wholly for nonedible products (table 17). Though soaps take about half of all the vegetable oils going to inedible uses, the use of

[64] R. E. Marsh and W. H. Gibbons, *op. cit.* pp. 484 and 485.

TABLE 17.—*Vegetable oils and their industrial uses, 1938*

[Millions of pounds]

Oil	Soap	Paint and varnish	Linoleum and oilcloth	Printing inks	Miscellaneous products	Total nonedible uses	Grand total edible and nonedible uses
Cottonseed	3				3	6	1, 540
Coconut	343	1			4	348	555
Corn	3				3	6	73
Soybean	11	15	4		5	35	237
Linseed	1	217	55	17	8	298	298
Tung		78	4	2	3	87	87
Perilla		24	7	2		33	33
Castor	2	5	1		20	28	28
Palm	92				20	112	253
Total	455	340	71	21	66	953	[1] 3, 166

[1] Total includes 62 million pounds of edible peanut oil.

SOURCE: Adapted from W. B. Van Arsdel, "The Industrial Market for Farm Products," *Farmers in a Changing World, Yearbook of Agriculture, 1940*, Washington, p. 623

TABLE 18.—*Soybeans, acreage and production, 1929 and 1939*

State	Total acreage		Total production (bushels)	
	1939	1929	1939	1929
Alabama	299, 817	90, 295	61, 884	41, 312
Arizona	80	17	33	81
Arkansas	595, 685	54, 307	551, 788	65, 869
California	71		661	
Colorado	598	583	1, 532	2, 498
Connecticut	553	760	740	159
Delaware	44, 631	24, 813	330, 531	211, 191
District of Columbia	50	120		
Florida	4, 009	2, 298	671	2, 591
Georgia	240, 374	39, 647	67, 637	68, 089
Idaho	24	171	144	2, 204
Illinois	2, 647, 238	496, 377	44, 771, 860	3, 249, 996
Indiana	1, 308, 974	321, 627	13, 763, 282	1, 379, 279
Iowa	1, 254, 425	152, 406	11, 359, 475	573, 711
Kansas	39, 827	18, 680	88, 322	29, 906
Kentucky	172, 350	101, 677	277, 410	70, 189
Louisiana	516, 873	216, 648	198, 317	191, 161
Maine	194	2, 064	491	322
Maryland	60, 149	26, 471	179, 789	54, 363
Massachusetts	406	1, 001	668	87
Michigan	115, 794	6, 112	824, 505	13, 251
Minnesota	183, 601	5, 628	466, 585	3, 380
Mississippi	727, 136	67, 939	264, 945	76, 719
Missouri	512, 396	362, 888	1, 090, 829	725, 114
Montana	77	371	146	1, 973
Nebraska	10, 076	2, 595	20, 566	1, 785
Nevada [1]				
New Hampshire	966	1, 095	283	55
New Jersey	24, 595	3, 058	48, 984	3, 164
New Mexico	241	303	509	2, 340
New York	18, 186	3, 241	97, 373	3, 781
North Carolina	751, 309	376, 806	1, 650, 314	1, 047, 201
North Dakota	2, 832	502	9, 966	195
Ohio	808, 648	96, 944	10, 293, 393	316, 462
Oklahoma	20, 749	21, 371	7, 580	52, 893
Oregon	4	301	6	88
Pennsylvania	70, 443	11, 626	159, 533	7, 860
Rhode Island	163	31	322	34
South Carolina	143, 990	31, 174	76, 677	47, 326
South Dakota	1, 483	2, 169	5, 369	419
Tennessee	437, 725	196, 509	126, 154	104, 163
Texas	18, 595	4, 523	16, 000	13, 404
Utah	20	145	238	5, 006
Vermont	1, 784	384	1, 397	47
Virginia	204, 895	122, 041	594, 890	261, 234
Washington	50		654	
West Virginia	47, 490	24, 639	11, 805	10, 714
Wisconsin	169, 299	18, 391	166, 355	18, 451
Wyoming	59	231	28	1, 121
U. S. total	11, 458, 934	2, 910, 979	87, 590, 641	8, 661, 188

[1] No report on soybeans.

SOURCE: U. S. Census.

some of the more unsaturated oils, such as tung, perilla, and linseed, and some soybean, as a drier in paints and varnishes, is well known and still very important in spite of the increasing use of competitors

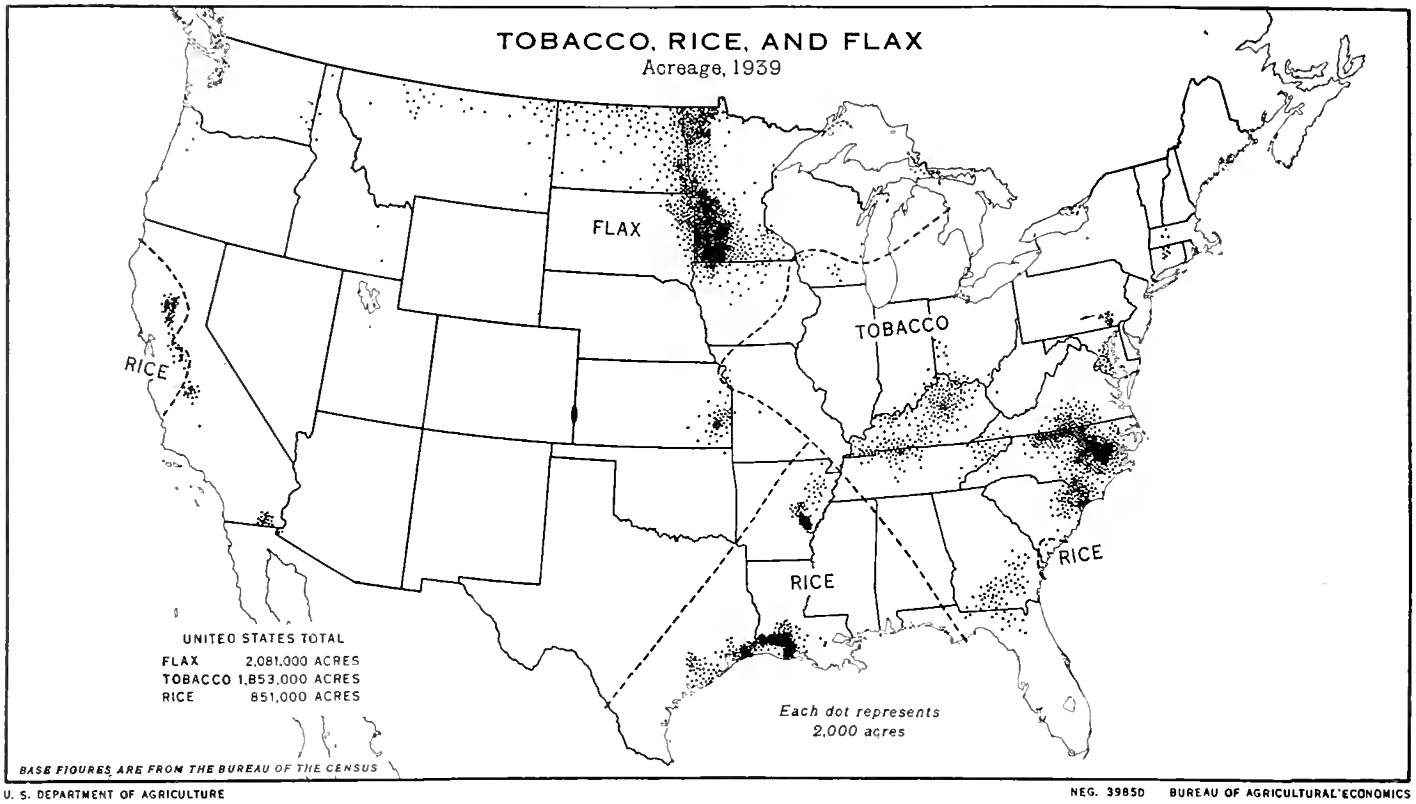


FIGURE 40

from nonvegetable sources, the petroleum and fishing industries.

Though our farms produce an abundance of cottonseed for cottonseed oil, large amounts of oil, oil seeds, and oil-source materials are imported, amounting in 1940 to 2,600 million pounds valued at approximately $100 million. In the same year we exported oil seeds and vegetable oils to a value of less than $10,000,000. Especially prominent among the imports are palm oil, coconut oil, copra, linseed, and tung.

Soybeans deserve special mention. Of a total of 11,462,000 acres of soybeans grown for all purposes in the 27 more commercial soybean States in 1940, only 4,961,000 acres were harvested for beans.[65] That acreage provided 79,837,000 bushels, as against a harvested crop of 91,272,000 bushels from 4,417,000 acres in 1939.[66] Most of this production was in those States for which soybean acreage and production figures from the Census of 1940 are shown in table 18. Production of soybean oil during 1940 was 536,987,000 pounds,[67] a figure which included a minor amount of imports (4,849,000 pounds [68]). The bushels of beans crushed during the same period amounted to 57,697,000.[69]

If 70,000,000 bushels of the 1940 harvested crop had been pressed for oil, leaving the remainder for seed, the resulting product would have been about 840,000,000 pounds of oil. This is allowing that the recoverable oil amounts to 20 percent of the weight of the beans.[70] The remainder, about 80 percent by weight, is high-grade protein, about 95 percent of which can be used for livestock feed and fertilizer, but which might be, and is now in part, a basis for the plastics industry.

Among chemicals should be mentioned the products of wood distillation, those from hardwoods being wood alcohol (methanol produced from "wood distillation and charcoal manufacture" in 1937 amounted to nearly 4 million gallons valued at $1,133,000), acetate of lime, and wood charcoal. From softwoods of the Gulf and Atlantic Coasts, either from the forest turpentine industry or by distilling resinous stumps and roots, turpentine (35,460,900 gallons), rosin (2,612,391 barrels, each of 500 pounds weight), and charcoal were produced in 1938–39. Even so, we imported in 1940, gums, resins, and balsams in considerably larger value

[65] *General Crop Report*, December 1940, p. 79.
[66] *Ibid.*, p. 1.
[67] *The Fats and Oils Situation*, Bureau of Agricultural Economics, U. S. Department of Agriculture, February 1941, p. 10.
[68] *Ibid.*, p. 11.
[69] *Ibid.*, p. 17.
[70] W. B. Van Arsdel, "The Industrial Market for Farm Products," *Yearbook of Agriculture, 1940*, p. 614.

than our exports of such items—$17,389,993 against $12,097,636.

Casein in amounts of as much as 30,000 tons annually, requiring over a billion pounds of skimmed milk, is being used, mostly in the rapidly growing plastics industry. Soybean meal also is increasingly used as basic material for plastics. Furfural from oat hulls is used in small amounts in the making of lacquers and dyes. Starches from corn, potatoes, and sweetpotatoes have important industrial uses.

Drugs, herbs, and essential oils are, of course, produced to some extent in the United States. The peppermint oil industry is fairly well developed on the muck lands of northern Indiana and southern Michigan. But, on the whole, either because of the lack of suitable growing conditions or more likely the higher labor cost here, we import drugs, herbs, leaves, and roots to a value in excess of $15,000,000 per year and essential oils in value of $6,406,000. Our exports of such materials are valued at little more than $2,000,000.

Tobacco is one of our important crops. Production in 1940 of all types amounted to 1,376,471 pounds, a little more than the average for the 10-year period 1929–38.[71] Special soil conditions in some of the area indicated in figure 40 favor production as do the skills acquired in growing and processing. Even so, it is reasonably certain that production can be expanded to meet any probable market demand—the difficulty at present is that of supply exceeding demand, except for a few special types. For mixing with domestic types we imported in 1940, $36,721,805 worth of unmanufactured tobacco, mostly cigarette leaf. In addition manufactured tobacco valued at $3,712,013 was imported, mostly from the Philippines. In the same year, exports of manufactured and unmanufactured tobacco were valued at $57,469,870.

[71] *General Crop Report*, December 1940, p. 1.

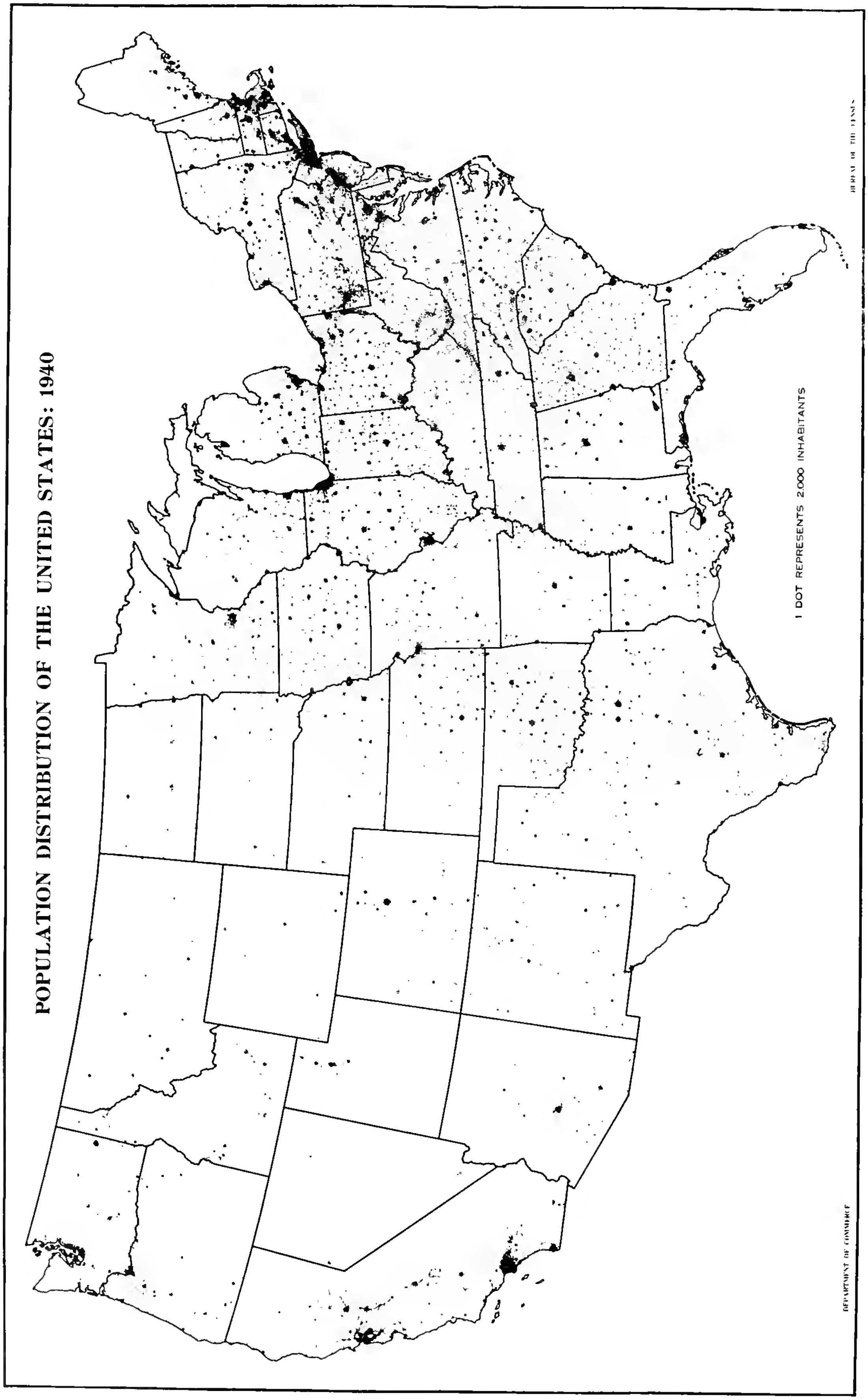

POPULATION DISTRIBUTION OF THE UNITED STATES: 1940
1 DOT REPRESENTS 2,000 INHABITANTS

FIGURE 41

CHAPTER 3—MAJOR GROUPS OF ECONOMIC ACTIVITY

By P. Sargant Florence and Ruth Friedson*

This chapter will sketch the distribution of the working population, providing a rough outline of the areal pattern of industry, and block out the geographic structure of production in terms of the major groups of economic activity. It indicates generally specialization in production within different sections of the United States and identifies the broad areas of concentration for particular groups of industry. Such a background is a prerequisite to the evaluation of trends in the location of industries and to the specific measurement of locational relationships developed in chapters 4 and 5; moreover, it provides a frame of reference for the discussion of probable alternative effects of various locational policies on the geographic structure of the national economy.

Density of Population as an Index of Economic Activity

While immobility of population, differential reproduction rates, and various other factors have resulted in a distribution of population not directly related to productive activity, differences in population density serve as a rough index of the relative extent of economic activity among varicus areas. A high density usually points to intensity of production and often to the development of peculiarly "urban" activities, mainly manufacturing and services, occurring in greater proportions in the more densely settled areas and requiring the use of comparatively little land.

Figure 41 shows the density of population in the United States in 1940. The most obvious feature of this map is the uneven distribution between East and West. With the exception of a few areas on the Pacific coast, the western half of the United States has a relatively sparse population, rarely more than 25 persons per square mile (on a county basis) and with large areas of fewer than 5 persons per square mile. East of a line slanting from Lake Superior through central Texas almost all counties have at least 25 persons per square mile. Toward the Atlantic coast the density increases and reaches the highest levels in the Northeast, in the Middle Atlantic States, and in Southern New England. The Southeast is marked by a density of between 25 and 100 persons per square mile, with a fairly pronounced band of counties in the lower Appalachian and Piedmont region of more than 100 persons per square mile. Areas of greatest population density are indicated in Figure 42, showing metropolitan areas of the United States in 1940. According to a recent study, population is still spreading out more evenly over the country as reflected in a consistently more uniform State density. In order to have obtained a distribution of population among the States directly proportionate to land areas it would have been necessary in 1850 to shift 66 percent of the population across present State lines, but in 1940 the required shift would have been only 42 percent. This percentage has fallen little, however, since 1910.[1]

The relationship between population and area is further illustrated by Figure 43, which shows the proportion of total land area and population of the United States included in each of the nine census regions. Before considering variations in the utilization of resources as reflected by the distribution of gainful workers, one should note that differences in population-area ratios between the East and the West as a whole and between some regions in the West result in large part from the presence of semiarid and mountainous tracts which support relatively few inhabitants.

Gainful Workers as a Measure of Economic Activity

Employed workers, as defined in the Census of Population, constituted 34.3 percent of the total population of the United States in 1940. The proportion of the total population of each State in the labor force[2] ranged from 26.4 percent in New Mexico to 39.8 percent in Connecticut.

In the following discussion, the number of employed workers has been used as the measure of relative incidence of the major groups of economic activity among various areas. Although "employed workers" do not reflect all the factors determining the comparative geographic importance of industries, they provide the *only uniform basis available* for measuring and comparing the distribution of *all* types of economic activities. Furthermore, in some ways "employed workers" are a better unit of measurement of relative activity

*Respectively, Consultant, National Resources Planning Board (Professor of Economics, University of Birmingham, England); and Assist-
Introduced in 1940, included the involuntarily unemployed.

[1] Edgar M. Hoover, "Interstate Redistribution of Population," *Journal of Economic History*, fall, 1941.

[2] Labor force is here used to include all employed persons and not merely wage earners.

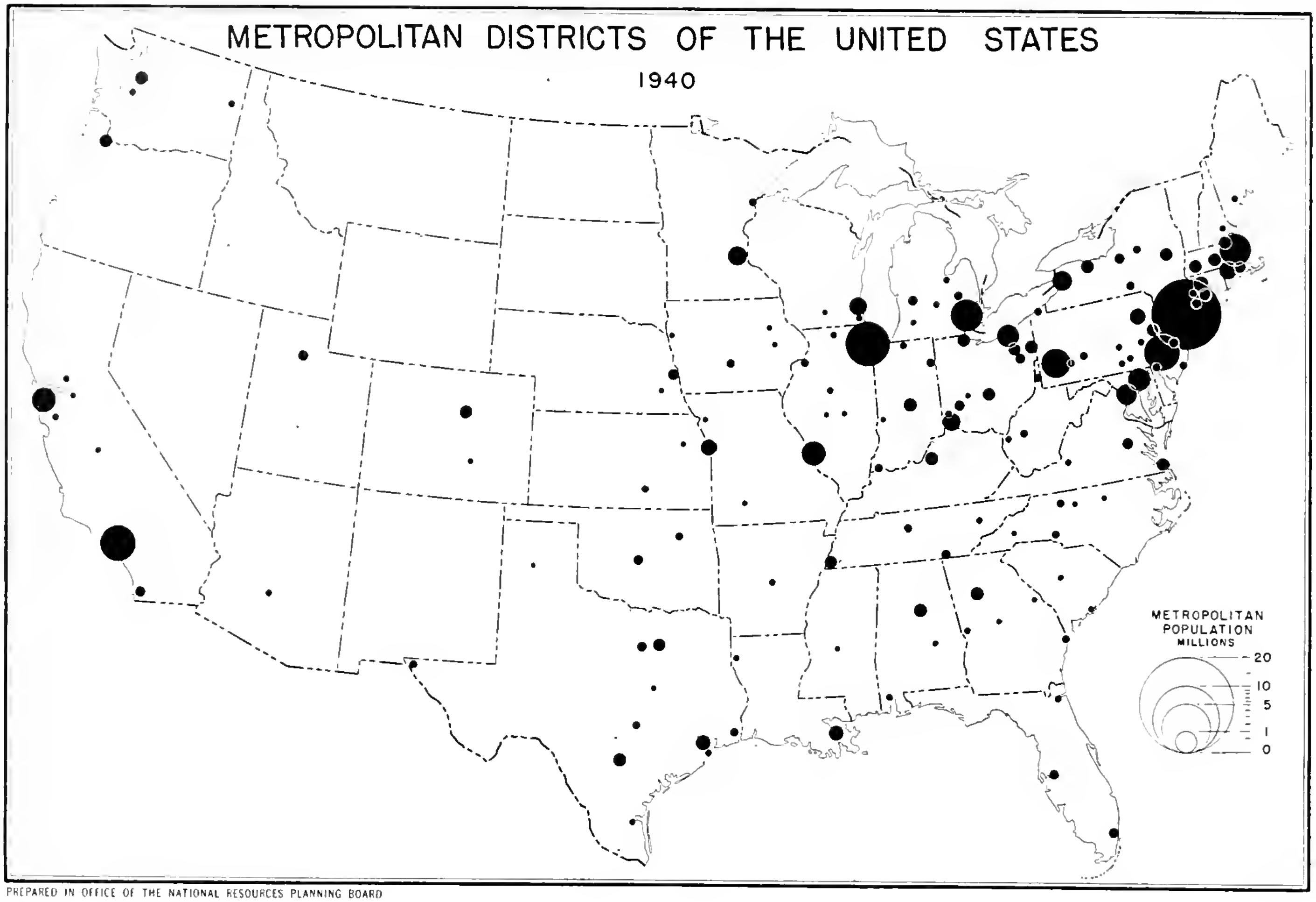


FIGURE 42

than either "value of products" or "value added," which are available for manufacturing only. The former includes the value of raw materials, and for both, comparisons between different periods would be distorted if changes in the price level took place. "Employed persons" is a better unit of measurement than manufacturing wage earners since the Census of Population, from which data on employed persons are taken, is not restricted by nondisclosure rules as is the Census of Manufactures, the source of information on wage earners. As has been indicated, the Census of Population is not limited to manufacturing. Data on gainful workers[3] for 1930 are used only where no comprehensive data are as yet available for any later period.

Major Economic Groups

Viewed broadly, economic activities may be classed as (1) agricultural, (2) other extractive, (3) manufacturing, and (4) service, including building, transportation, and trade. Extractive activities, such as agriculture, mining, forestry, and fishing, are located at the sites of the natural resources they exploit. Services are usually close to consumers, and their distribution, therefore, corresponds roughly to that of population. Building is distributed more or less as the population[4] and may, for practical purposes, be treated as a service. No such general rule can be given, however, for the location pattern of manufacturing as a whole. Some manufactures are located close to resources, other near markets, and still others are "footloose"; some are widely distributed, while others are concentrated in specific "localizations."

Basic to an understanding of the problem of industrial location is recognition of the geographic specialization in production in the United States. National occupational statistics show that the Southern States, with one-quarter of all employed workers, accounted in 1940 for roughly half the labor force in

[3] In 1930, the Census of Population covered "persons engaged in gainful occupations" and, unlike the category "employed workers" introduced in 1940, included the involuntarily unemployed.

[4] Distribution of building and the other services relative to population is modified chiefly by regional variations in income pattern and extent of urbanization, as indicated in later sections of this chapter.

agriculture; that the Northeastern States, with 50 percent of workers in all industry, included about 70 percent of those employed in manufacturing; and that Pennsylvania and West Virginia, with less than 10 percent of all employed workers between them, had almost 60 percent of those engaged in coal mining.

Existence of a great national market and differences among sections of the United States in basic natural resources, in character of the population, and in industrial evolution explain the general tendency for each area to specialize its production. While no State is self-sufficient, neither does any State devote its entire productive activity to one field. For example, although farming is the dominant activity in Iowa (one-third of all employed workers in 1940). 21 percent of the workers were in trade, 11 percent in manufacturing, 7 percent in transportation, and 7 percent in personal services. In Georgia, where the production of cotton dominates the economy and one-third of the workers were employed in agriculture, 19 percent were engaged in manufacturing, 13 percent in domestic and personal service, and 15 percent in trade. It is clear that wherever there is any dominant activity there is also required a minimum effort in several other types of economic enterprise. We find that transportation, trade, building, and the services do not dominate the economy of any region but rather occur wherever there are goods to be moved and distributed and people to be housed and served.

Table 1 shows the distribution of all gainful workers in the United States among the major groups of industry in 1940. Manufacturing engaged the largest single group, more than one-fifth of the entire labor force. This was the second decennial census year in which manufacturing exceeded agricultural in numerical importance. Building, transportation, and trade, when grouped with the other services, totaled 54 percent of all gainful workers, greater than the combined total of manufacturing and agriculture.

A rough measure of the geographic concentration of these major groups of economic activity is provided by the coefficient of localization,[5] which compares the distribution among States of a particular industry or group of industries with that of all industries. The lower the coefficient, the more evenly dispersed is the industry in question, and the higher the coefficient, the

[5] For method of computation, see chapter 5.

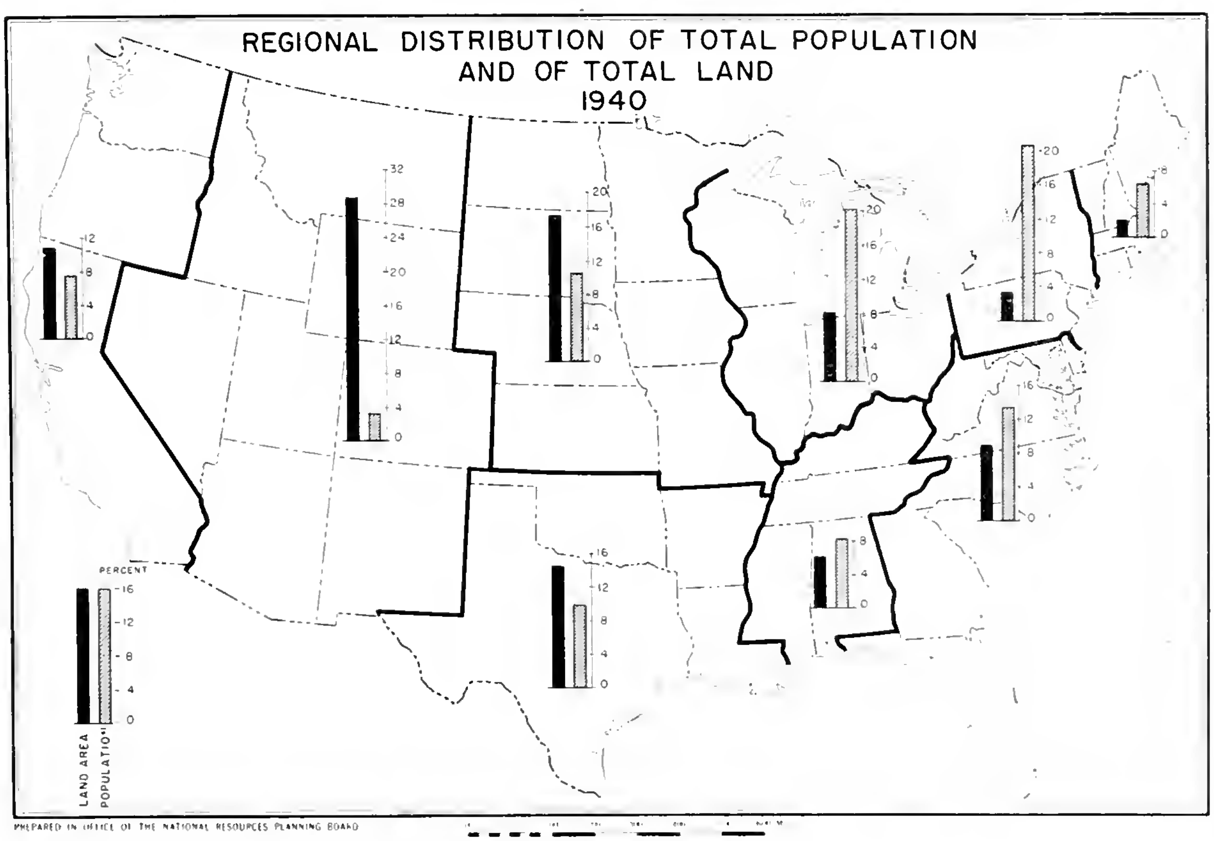


FIGURE 43

TABLE 1.—*Economic structure of the United States in terms of major groups of industry with measures of the localization of these groups, 1940*

Industry groups	Percentage of total employed	Coefficient of localization [1]
Agriculture	18.54	0.326
Forestry and fishing	.23	.476
Coal mining	1.17	.649
Crude petroleum and natural gas products	.41	.620
Other mines and quarries	.45	.388
Total extractive	20.80	
Manufacturing	23.41	.188
Construction	4.55	.065
Transportation and communication	6.89	.091
Trade	21.85	.086
Personal services	8.88	.084
Professional services	8.22	.074
Government	3.88	.137
Total service	54.27	
Industry not reported	1.52	

[1] The coefficient of localization measures complete coincidence of a particular industry with the distribution of all industry among the States as 0 and complete differentiation approaches 1. See ch. 4 for exact method of computation.

more concentrated that industry relative to all industry. The extractive industries have the highest coefficients but even these "material-oriented" activities show wide variations in degree of concentration (table 1). Coal mining has a coefficient almost twice as great as that for agriculture, while the latter is in turn almost twice as large as the coefficient for manufacturing, the most concentrated of the nonextractive groups. Construction is the most evenly dispersed of any group over the whole occupied population.

The tendency for the several services to scatter in conformity with the population, and for manufacturing and the extractive industries to localize will be considered in the following sections. The basic data on the distribution of industries among States are included in table 2, which shows the percentage of all employed workers in the United States included in each State for 12 major groups of industry and 18 subdivisions of manufacturing; and in table 3, which gives the same break-down for the total employed workers within each State.

Agriculture

Agriculture must perforce be located in relation to the distribution of arable land, but not all arable land is devoted to agriculture. The geographic location of agricultural activity has deviated from the pattern dictated by type and quality of resources owing to population movements and the historical development of other productive activities. Alternative uses for land, custom, and many other factors also account for the use of arable land for purposes other than agriculture.

TABLE 2.—*Percentage distribution among the States of employed persons in each major group of economic activity, 1940*

	United States basic pattern	Division								
		New England						Middle Atlantic		
		Maine	New Hampshire	Vermont	Massachusetts	Rhode Island	Connecticut	New York	New Jersey	Pennsylvania
All industries	100.00	0.62	0.39	0.28	3.40	0.59	1.51	11.01	3.47	7.15
Industry groups:										
Agriculture	18.54	.44	.18	.37	.43	.06	.32	2.51	.57	2.30
Forestry and fishing	.23	3.14	.62	.26	5.49	.58	.83	2.65	1.80	.96
Coal mining	1.17	.00	.00	.00	.01	.00	.00	.03	.02	38.78
Oil and gas wells	.41	.00	.00	.00	.03	.00	.00	1.27	.03	5.59
Other mines and quarries	.45	.26	.15	.72	.70	.08	.28	3.15	1.68	5.09
Construction	4.55	.58	.44	.27	3.34	.63	1.62	11.79	3.81	6.94
Manufacturing	23.41	.87	.66	.26	5.33	1.15	2.80	12.84	5.41	10.15
Transportation, communication, etc.	6.89	.55	.29	.25	3.21	.41	1.06	13.25	4.08	7.98
Trade	21.85	.53	.32	.22	3.85	.57	1.46	14.17	3.90	6.90
Wholesale and retail trade	16.69	.55	.33	.22	3.82	.59	1.37	13.04	3.52	7.01
Finance, insurance, and real estate	3.25	.36	.24	.17	4.27	.49	2.01	20.34	6.01	6.42
Business and repair services	1.91	.63	.39	.30	3.43	.49	1.32	13.63	3.65	6.75
Personal services	8.88	.66	.40	.31	3.23	.48	1.37	12.31	3.25	6.20
Professional services	8.23	.60	.41	.28	4.23	.57	1.57	13.90	3.53	7.05
Amusement, recreation, etc.	.88	.45	.26	.16	3.15	.45	1.07	15.65	3.01	5.59
Professional and related services	7.35	.62	.42	.30	4.36	.58	1.63	13.69	3.59	7.22
Government	3.88	.65	.33	.30	3.72	.68	1.23	12.41	3.14	5.78
Industry group not specified	1.53	.80	.49	.36	3.91	.48	1.73	16.52	5.38	7.93
Manufacturing subdivided.										
Food and kindred products	2.42	.47	.78	.20	3.31	.37	.83	10.95	3.66	7.41
Textile-mill products	2.59	1.99	1.36	.35	10.85	4.89	3.41	8.75	5.40	12.22
Apparel and other fabricated textile production	1.73	.19	.07	.12	4.16	.37	2.32	36.31	8.42	11.95
Logging	.31	4.27	2.00	.95	.56	.07	.19	1.51	.14	2.29
Sawmills and planing mills	.96	.97	.63	.66	.50	.06	.24	1.53	.44	2.07
Furniture, store fixtures, and miscellaneous wooden goods	.80	1.29	1.08	.65	3.86	.27	.64	11.32	2.69	6.24
Paper and allied products	.73	4.26	1.97	.43	8.82	.41	1.65	15.60	4.19	8.32
Printing, publishing, and allied industries	1.40	.35	.31	.18	4.67	.46	1.44	18.46	4.29	7.10
Chemicals and allied products	.97	.12	.06	.04	3.28	.32	1.61	13.26	11.76	7.11
Petroleum and coal products	.45	.07	.02	.01	1.52	.41	.32	6.48	9.99	11.04
Leather and leather products	.81	4.81	5.96	.18	19.26	.19	.89	18.77	3.15	7.84
Stone, glass, and clay products	.75	.22	.27	1.03	2.11	.21	.75	8.60	6.46	14.88
Iron and steel and their products	2.80	.13	.10	.07	3.31	1.00	3.97	6.79	3.44	21.76
Nonferrous metals and their products	.62	.05	.07	.02	5.08	1.28	15.12	14.19	6.18	8.42
Machinery	2.37	.33	.34	.36	6.52	1.15	4.61	11.99	6.72	9.60
Automobiles and automobile equipment	1.27	.01	.01	.00	.66	.04	.38	4.42	2.27	2.89
Transportation equipment except automobiles	.68	1.55	.78	.01	6.13	.10	4.60	12.31	10.02	10.69
Manufacturing industry not specified	1.76	.18	.35	.26	6.30	2.39	4.90	18.76	8.66	8.30

SOURCE: *Census of Population*, 1940.

TABLE 2.—*Percentage distribution among the States of employed persons in each major group of economic activity, 1940*—Continued

	Division											
	East North Central					West North Central						
	Ohio	Indiana	Illinois	Michigan	Wisconsin	Minnesota	Iowa	Missouri	North Dakota	South Dakota	Nebraska	Kansas
All industries	5.19	2.55	6.36	4.04	2.35	2.06	1.91	2.87	0.44	0.45	0.96	1.29
Industry groups:												
Agriculture	3.07	2.45	3.39	2.56	3.27	3.37	3.69	3.65	1.28	1.17	1.93	2.19
Forestry and fishing	.93	.39	1.04	2.05	1.66	.76	.28	.53	.06	.14	.19	.15
Coal mining	4.42	1.88	6.55	.18	.01	.01	.98	.76	.18	.01	0	.45
Oil and gas wells	1.83	.60	5.91	1.68	.02	.02	.04	.20	.01	.02	.06	5.56
Other mines and quarries	2.85	1.22	1.91	5.83	1.20	3.88	.54	4.00	.02	1.38	.25	1.30
Construction	4.93	2.44	5.70	3.56	1.92	1.82	1.76	2.75	.20	.30	.83	1.21
Manufacturing	7.41	3.27	7.77	6.62	2.55	1.10	.93	2.32	.05	.09	.28	.50
Transportation, communication, etc	5.58	2.58	8.28	3.22	1.95	2.09	1.82	3.18	.33	.29	1.08	1.60
Trade	5.29	2.42	7.54	3.82	2.14	2.24	1.87	3.13	.35	.38	.99	1.31
Wholesale and retail trade	5.42	2.50	7.44	3.92	2.22	2.29	1.92	3.16	.36	.40	.99	1.35
Finance, insurance, and real estate	4.58	1.97	7.99	3.28	1.68	1.96	1.49	2.98	.21	.24	.95	1.05
Business and repair services	5.32	2.49	7.64	3.88	2.24	2.27	2.05	3.09	.43	.47	1.09	1.46
Personal services	4.41	1.96	5.60	3.15	1.73	1.73	1.44	2.74	.30	.29	.78	1.07
Professional services	5.17	2.39	6.39	3.70	2.32	2.35	2.01	2.75	.46	.52	1.07	1.43
Amusement, recreation, etc	4.85	2.07	6.75	3.66	1.73	1.92	1.53	2.39	.28	.38	.84	1.11
Professional and related services	5.21	2.43	6.34	3.70	2.39	2.41	2.07	2.79	.48	.54	1.10	1.17
Government	4.16	1.87	5.70	3.14	1.76	1.87	1.35	2.27	.40	.42	.95	1.33
Industry group not specified	4.72	2.65	5.51	3.49	2.09	1.65	2.22	2.58	.38	.40	.70	1.25
Manufacturing subdivided:												
Food and kindred products	4.83	3.21	10.43	3.55	3.49	3.20	3.03	3.65	.25	.46	1.35	1.77
Textile-mill products	.88	.72	1.18	.54	.98	.31	.12	.22	0	0	.01	.01
Apparel and other fabricated textile production	3.00	2.18	6.25	.94	.62	.72	.36	3.43	.01	01	.08	.29
Logging	.54	.50	.47	3.64	2.33	2.04	.18	1.55	01	20	.03	.12
Sawmills and planing mills	1.34	1.35	1.38	1.67	2.53	.84	.96	1.56	01	17	07	.14
Furniture, store fixtures, and miscellaneous wooden goods	5.60	5.38	9.38	6.33	3.67	1.18	.84	2.11	.02	.03	22	36
Paper and allied products	6.92	1.92	6.47	6.11	6.70	1.50	.29	1.77	0	.01	.09	.34
Printing, publishing, and allied industries	6.43	2.31	11.76	3.64	2.25	2.14	1.63	3.07	.19	25	80	1.21
Chemicals and allied products	6.18	1.91	6.89	4.33	.98	.86	.65	2.50	.01	.04	.18	.62
Petroleum and coal products	4.31	4.00	7.72	1.60	.32	.39	.15	1.76	.03	.05	.17	2.62
Leather and leather products	4.71	.84	7.80	1.33	5.07	.37	.21	9.10	0	.02	07	.05
Stone, glass, and clay products	15.06	4.79	6.88	2.76	.93	1.52	1.20	3.03	.02	08	25	57
Iron and steel and their products	16.27	5.72	10.79	4.99	2.38	.76	.66	1.61	.01	01	.09	.24
Nonferrous metals and their products	6.79	2.35	10.66	4.78	3.09	.66	.33	1.68	.03	.04	.18	.33
Machinery	12.77	5.39	14.98	5.67	4.81	1.09	1.47	2.03	.03	04	.18	25
Automobiles and automobile equipment	7.75	6.06	2.40	61.87	3.08	.40	.11	1.80	.01	0	.05	12
Transportation equipment except automobiles	3.12	2.16	3.57	1.76	.82	.17	.15	1.27	0	0	07	.57
Manufacturing industry not specified	11.01	3.09	7.56	4.34	1.89	.70	1.08	1.88	.02	.02	.20	.16

	Division								
	South Atlantic								
	Delaware	Maryland	District of Columbia	Virginia	West Virginia	North Carolina	South Carolina	Georgia	Florida
All industries	0.23	1.53	0.68	2.07	1.15	2.68	1.46	2.45	1.51
Industry groups:									
Agriculture	.17	.82	.01	2.66	.95	4.85	3.11	4.49	1.39
Forestry and fishing	.17	4.05	.04	6.65	.28	3.03	1.01	13.12	12.10
Coal mining	0	.53	0	3.81	20.10	.02	0	.04	0
Oil and gas wells	.01	.01	.01	.02	2.99	.01	.01	.02	.03
Other mines and quarries	.04	.59	.05	1.99	.97	1.38	.65	1.89	1.25
Construction	.34	1.91	.96	2.36	1.01	2.28	1.09	2.03	2.13
Manufacturing	.28	1.71	.21	1.77	.87	3.08	1.43	1.94	.76
Transportation, communication, etc	.25	1.87	.68	2.06	1.26	1.32	.62	1.68	1.46
Trade	.20	1.52	.73	1.48	.80	1.58	.77	1.64	1.75
Wholesale and retail trade	.20	1.52	.70	1.53	.85	1.68	.82	1.72	1.85
Finance, insurance, and real estate	.20	1.58	1.00	1.29	.50	1.05	.55	1.32	1.42
Business and repair services	.20	1.44	.61	1.37	.79	1.55	69	1.49	1.45
Personal services	.26	1.73	1.17	2.35	.93	2.88	1.77	3.56	2.91
Professional services	.20	1.51	.88	1.62	1.03	1.87	.95	1.63	1.46
Amusement, recreation, etc	.17	1.56	.69	1.24	.75	1.45	.65	1.39	2.51
Professional and related services	.20	1.50	.90	1.67	1.07	1.92	.99	1.66	1.34
Government	.22	2.63	5.10	3.76	.76	1.54	.99	2.16	1.62
Industry group not specified	.37	2.09	.54	1.74	1.05	2.29	.84	1.75	1.50
Manufacturing subdivided:									
Food and kindred products	.23	2.10	.29	1.41	.51	1.23	.54	1.65	1.48
Textile-mill products	.28	.49	.01	2.59	.30	16.24	8.59	7.25	.04
Apparel and other fabricated textile production	.25	2.98	.02	1.25	.26	81	.30	2.10	.14
Logging	.04	.45	0	2.90	2.67	4.34	2.47	3.17	4.42
Sawmills and planing mills	.16	.73	.03	4.94	1.71	6.30	3.62	5.69	3.44
Furniture, store fixtures, and miscellaneous wooden goods	.26	1.15	.07	3.40	.37	6.75	1.03	2.11	1.81
Paper and allied products	.08	1.22	.10	2.20	.57	1.60	.86	1.27	.98
Printing, publishing, and allied industries	.13	1.75	1.51	1.12	.48	.86	.34	1.03	1.00
Chemicals and allied products	2.11	3.67	.07	4.69	3.45	2.09	.97	2.69	1.09
Petroleum and coal products	.27	1.34	.03	.33	85	.13	.13	.48	.17
Leather and leather products	.68	1.20	.01	1.54	.44	.36	.02	.75	.03
Stone, glass, and clay products	.07	1.64	.17	1.36	5.12	1.26	.60	1.69	.65
Iron and steel and their products	.15	2.71	.48	.40	1.47	.17	.05	.43	.11
Nonferrous metals and their products	.08	1.46	.08	.34	.85	.51	.05	.30	.16
Machinery	.06	.80	.06	.18	22	.27	10	40	.15
Automobiles and automobile equipment	.02	.51	.02	.25	.02	.14	03	47	.08
Transportation equipment except automobiles	.63	5.65	.04	6.69	.26	17	1.07	11	.68
Manufacturing industry not specified	.22	1.22	.06	2.31	38	3.06	30	43	1.40

TABLE 2.—*Percentage distribution among the States of employed persons in each major group of economic activity, 1940*—Continued

	Division							
	East South Central				West South Central			
	Kentucky	Tennessee	Alabama	Mississippi	Arkansas	Louisiana	Oklahoma	Texas
All industries	1.88	2.09	1.98	1.61	1.29	1.71	1.46	4.74
Industry groups:								
Agriculture	3.69	3.73	4.22	5.01	3.58	2.97	2.60	7.60
Forestry and fishing	.44	.98	2.79	2.46	1.42	7.20	.19	2.61
Coal mining	10.37	1.81	4.37	0	.31	0	.29	.12
Oil and gas wells	1.39	.05	.05	.71	1.26	7.18	16.21	30.45
Other mines and quarries	1.64	2.36	3.49	.30	.96	.80	1.84	2.23
Construction	1.73	2.08	1.40	1.17	.84	1.70	1.31	5.38
Manufacturing	.95	1.63	1.47	.63	.54	.94	.48	2.00
Transportation, communication, etc.	1.71	1.65	1.21	.70	.80	1.62	1.07	4.51
Trade	1.37	1.59	1.13	.73	.80	1.41	1.47	4.86
Wholesale and retail trade	1.41	1.67	1.19	.79	.85	1.49	1.51	5.06
Finance, insurance, and real estate	1.03	1.24	.86	.40	.49	1.02	1.16	3.83
Business and repair services	1.54	1.55	1.04	.72	.84	1.29	1.63	4.94
Personal services	1.60	2.44	2.36	1.66	1.15	2.34	1.40	5.90
Professional services	1.39	1.58	1.26	.89	.85	1.41	1.54	4.17
Amusement, recreation, etc.	1.20	1.12	.83	.56	.73	1.51	1.39	4.14
Professional and related services	1.42	1.63	1.31	.93	.86	1.40	1.56	4.17
Government	1.48	1.33	1.22	.70	.72	1.31	1.45	4.51
Industry group not specified	1.58	1.59	1.47	1.01	1.13	1.12	1.59	3.62
Manufacturing subdivided:								
Food and kindred products	1.65	1.48	.93	.73	.57	1.90	1.11	3.79
Textile-mill products	.30	3.19	3.82	.46	.07	.24	.08	.64
Apparel and other fabricated textile production	1.06	1.82	.46	.93	.19	.48	.08	1.38
Logging	1.38	2.36	2.81	3.25	4.41	3.83	1.27	3.63
Sawmills and planing mills	1.81	3.68	6.26	5.42	5.80	4.63	.80	4.88
Furniture, store fixtures, and miscellaneous wooden goods	1.73	2.55	.73	.97	1.40	1.08	.43	2.53
Paper and allied products	.25	.76	1.13	.54	.73	2.45	.08	.85
Printing, publishing, and allied industries	1.17	1.30	.62	.29	.41	.75	.99	2.91
Chemicals and allied products	.57	4.02	1.34	1.04	.40	1.43	.30	2.13
Petroleum and coal products	.96	.35	.83	.10	.58	4.20	4.69	18.47
Leather and leather products	.86	1.69	.04	.01	.01	.03	.03	.33
Stone, glass, and clay products	1.02	1.69	1.23	.79	.45	1.10	.85	1.95
Iron and steel and their products	.94	1.02	2.72	.03	.05	.21	.22	.67
Nonferrous metals and their products	.86	2.20	.30	.06	.17	.24	.68	1.41
Machinery	.71	.32	.23	.07	.07	.21	.33	1.62
Automobiles and automobile equipment	.36	.42	.06	.03	.05	.09	.06	.51
Transportation equipment except automobiles	.18	.12	.75	.34	.02	67	.08	.98
Manufacturing industry not specified	1.41	1.24	.42	.12	.11	.36	.15	.66

	Division										
	Mountain								Pacific		
	Montana	Idaho	Wyoming	Colorado	New Mexico	Arizona	Utah	Nevada	Washington	Oregon	California
All industries	0.41	0.35	0.19	0.78	0.31	0.33	0.33	0.09	1.35	0.86	5.59
Industry groups:											
Agriculture	.71	.69	.30	.88	.54	.39	.34	.08	1.00	.85	3.17
Forestry and fishing	.67	.71	.15	.48	.27	.31	.32	.06	4.80	1.99	7.19
Coal mining	.30	.01	.79	1.47	.43	.01	.42	0	.50	.01	.02
Oil and gas wells	.44	.01	.96	.17	1.68	.03	.03	.61	.04	.02	13.33
Other mines and quarries	5.52	3.30	.19	3.88	1.72	6.29	3.87	3.69	1.35	1.42	10.45
Construction	.43	.35	.20	.87	.41	.43	.39	.15	1.82	1.01	7.38
Manufacturing	.13	.12	.04	.34	.08	.12	.15	.02	1.24	.77	3.94
Transportation, communication, etc.	.48	.33	.29	.93	.30	.36	.50	.17	1.65	.99	6.42
Trade	.37	.32	.16	.89	.27	.34	.37	.08	1.53	.96	7.48
Wholesale and retail trade	.39	.34	.16	.89	.29	.36	.38	.09	1.54	.98	7.32
Finance, insurance, and real estate	.24	.18	.09	.79	.13	.20	.30	.05	1.46	.80	8.13
Business and repair services	.45	.39	.21	1.05	.34	.37	.39	.10	1.62	1.07	7.85
Personal services	.28	.24	.14	.73	.29	.36	.23	.08	1.11	.74	5.98
Professional services	.42	.35	.20	.97	.35	.40	.40	.11	1.44	.94	7.48
Amusement, recreation, etc.	.37	.37	.17	.79	.26	.42	.37	.28	1.45	.94	15.39
Professional and related services	.43	.35	.20	1.00	.36	.39	.40	.08	1.44	.94	6.54
Government	.51	.32	.44	1.03	.36	.41	.41	.13	2.06	.85	8.52
Industry group not specified	.34	.36	.14	.85	.35	.30	.33	.12	1.20	.89	4.69
Manufacturing subdivided:											
Food and kindred products	.25	.27	.10	.89	.10	.21	.40	.04	1.53	.89	7.09
Textile-mill products	0	0	0	.01	.17	.20	.06	0	.06	.21	.51
Apparel and other fabricated textile production	.01	.01	0	.09	.01	.01	.08	0	.29	.19	3.00
Logging	.72	1.46	.17	.30	.23	.36	.05	.01	15.11	11.18	3.42
Sawmills and planing mills	.51	.82	.09	.26	.32	.31	.07	.02	7.97	6.40	4.21
Furniture, store fixtures, and miscellaneous wooden goods	.05	.05	.04	.20	.06	.17	.09	.01	1.42	1.24	5.11
Paper and allied products	0	0	0	.11	0	0	.04	0	2.93	1.09	2.39
Printing, publishing, and allied industries	.25	.22	.10	.69	.14	.22	.31	.05	1.24	.81	6.37
Chemicals and allied products	.02	.01	.01	.22	.07	.09	.12	.01	.42	.19	4.07
Petroleum and coal products	.39	.05	.74	.30	.14	.02	.27	0	.19	.13	10.88
Leather and leather products	.01	.01	0	.12	.01	.02	.02	0	.09	.08	.99
Stone, glass, and clay products	.06	.07	.07	.49	.17	.10	.19	.02	.62	.29	4.66
Iron and steel and their products	.02	.01	0	.55	.01	.03	.09	0	.41	.22	2.73
Nonferrous metals and their products	1.38	.28	.01	.40	.35	.79	1.30	.26	.85	.24	3.06
Machinery	.03	.03	.01	.18	.02	.03	.05	0	.30	.21	3.01
Automobiles and automobile equipment	.01	.01	0	.08	0	.01	.02	0	.14	.08	2.20
Transportation equipment except automobiles	.01	.07	.01	.03	.01	.01	.01	0	4.62	.17	16.59
Manufacturing industry not specified	.03	.03	.01	.48	.06	.03	.07	0	.30	.25	2.84

TABLE 3.—*Percentage distribution among industry groups of employed persons in the United States and each State, 1940*

	United States basic pattern	Division								
		New England						Middle Atlantic		
		Maine	New Hampshire	Vermont	Massachusetts	Rhode Island	Connecticut	New York	New Jersey	Pennsylvania
All industries—percent of United States total	100.0	0.62	0.39	0.28	3.40	0.59	1.51	11.01	3.47	7.15
Industrial groups—percent of each area total:										
Agriculture	18.54	13.07	8.77	24.46	2.34	1.90	3.89	4.23	3.06	5.96
Forestry and fishing	.23	1.16	.36	.21	.38	.23	.13	.06	.12	.03
Coal mining	1.17	.01	0	0	0	.01	0	0	.01	6.33
Oil and gas wells	.41	0	0	0	0	0	0	.05	0	.32
Other mines and quarries	.45	.19	.18	1.16	.09	.06	.08	.13	.22	.32
Construction	4.55	4.32	5.12	4.47	4.47	4.93	4.89	4.87	5.00	4.42
Manufacturing	23.41	32.84	39.51	21.96	36.76	45.81	43.46	27.29	36.45	33.21
Transportation, communication, etc	6.89	6.16	5.09	6.28	6.52	4.81	4.85	8.30	8.09	7.69
Trade	21.85	18.81	18.10	17.12	21.75	21.22	21.15	28.13	24.53	21.08
Wholesale and retail trade	16.69	14.98	14.17	13.05	18.74	16.87	15.14	19.76	16.90	16.36
Finance, insurance, and real estate	3.25	1.87	2.00	2.01	4.08	2.74	4.34	6.00	5.62	2.92
Business and repair services	1.91	1.96	1.93	2.06	1.93	1.61	1.67	2.37	2.01	1.80
Personal services	8.88	9.43	9.16	9.86	8.44	7.34	8.06	9.92	8.30	7.70
Professional services	8.23	7.98	8.54	8.32	10.24	7.94	8.58	10.37	8.36	8.10
Amusement, recreation, etc	.88	.64	.58	.49	.81	.67	.62	1.24	.76	.68
Professional and related services	7.35	7.34	7.96	7.83	9.43	7.23	7.96	9.13	7.60	7.42
Government	3.88	4.06	3.27	4.16	4.25	4.50	3.17	4.38	3.51	3.14
Industry group not specified	1.53	1.96	1.91	1.99	1.75	1.24	1.75	2.29	2.36	1.69
Manufacturing subdivided:										
Food and kindred products	2.42	1.86	1.13	1.72	2.36	1.51	1.33	2.41	2.55	2.51
Textile-mill products	2.59	8.36	9.03	3.27	8.27	21.61	5.87	2.06	4.03	4.43
Apparel and other fabricated textile production	1.73	.55	.31	.73	2.12	1.10	2.66	5.70	4.19	2.89
Logging	.31	2.16	1.60	1.08	.05	.04	.04	.04	.01	.10
Sawmills and planing mills	.96	1.51	1.56	2.31	.14	.10	.16	.13	.12	.28
Furniture, store fixtures, and miscellaneous wooden goods	.80	1.67	2.21	1.87	.91	.36	.34	.82	.62	.70
Paper and allied products	.73	5.01	3.66	1.14	1.89	.50	.80	1.03	.88	.84
Printing, publishing, and allied industries	1.40	.80	1.11	.91	1.92	1.10	1.33	2.34	1.72	1.39
Chemicals and allied products	.97	.19	.14	.14	.94	.53	1.04	1.17	3.30	.97
Petroleum and coal products	.45	.05	.02	.01	.20	.31	.09	.26	1.28	.69
Leather and leather products	.81	6.28	12.35	.53	4.57	.26	.47	1.38	.73	.88
Stone, glass, and clay products	.75	.27	.52	2.77	.46	.27	.37	.58	1.39	1.55
Iron and steel and their products	2.80	.60	.72	.71	2.72	4.79	7.36	1.73	2.77	8.51
Nonferrous metals and their products	.62	.05	.11	.05	.93	1.35	6.21	.80	1.10	.73
Machinery	2.37	1.25	2.08	3.06	4.56	4.65	7.27	2.58	4.59	3.19
Automobiles and automobile equipment	1.27	.03	.03	.01	.25	.08	.32	.51	.83	.52
Transportation equipment except automobiles	.68	1.70	1.36	.02	1.22	.11	2.07	.76	1.95	1.01
Manufacturing industry not specified	1.76	.50	1.57	1.63	3.26	7.15	5.71	2.99	4.38	2.04

	Division											
	East North Central					West North Central						
	Ohio	Indiana	Illinois	Michigan	Wisconsin	Minnesota	Iowa	Missouri	North Dakota	South Dakota	Nebraska	Kansas
All industries—percent of United States total	5.19	2.55	6.36	4.04	2.35	2.06	1.91	2.87	0.44	0.45	0.96	1.29
Industrial groups—percent of each area total:												
Agriculture	10.97	17.79	9.88	11.72	25.78	30.30	35.78	23.55	53.38	48.06	37.37	31.41
Forestry and fishing	.04	.03	.04	.12	.16	.08	.03	.04	.03	.07	.05	.03
Coal mining	.99	.86	1.20	.05	0	0	.60	.31	.47	.03	0	.41
Oil and gas wells	.14	.10	.38	.17	0	0	.01	.03	.01	.01	.02	1.75
Other mines and quarries	.25	.21	.13	.65	.23	.84	.13	.62	.02	1.36	.12	.45
Construction	4.32	4.36	4.08	4.01	3.72	4.02	4.20	4.36	2.03	3.04	3.92	4.26
Manufacturing	33.40	30.01	28.58	38.36	25.48	12.45	11.44	18.88	2.50	4.53	6.86	9.09
Transportation, communication, etc	7.41	6.96	8.97	5.50	5.73	7.00	6.57	7.63	5.07	4.37	7.79	8.52
Trade	22.25	20.71	25.89	20.68	19.94	23.72	21.38	23.78	17.14	18.38	22.57	22.19
Wholesale and retail trade	17.43	16.34	19.51	16.21	15.79	18.54	16.80	18.36	13.71	14.67	17.19	17.78
Finance, insurance, and real estate	2.86	2.50	4.08	2.63	2.33	3.08	2.53	3.36	1.57	1.73	3.20	2.65
Business and repair services	1.96	1.87	2.30	1.84	1.82	2.10	2.05	2.06	1.86	1.98	2.18	2.16
Personal services	7.55	6.83	7.82	6.92	6.56	7.46	6.70	8.47	6.09	5.68	7.18	7.32
Professional services	8.18	7.70	8.25	7.52	8.14	9.39	8.64	7.88	8.43	9.49	9.16	9.12
Amusement, recreation, etc	.82	.71	.93	.79	.65	.82	.70	.73	.55	.74	.76	.75
Professional and related services	7.36	6.99	7.32	6.73	7.49	8.57	7.94	7.15	7.88	8.75	8.40	8.37
Government	3.11	2.85	3.47	3.02	2.90	3.52	2.75	3.07	3.53	3.63	3.85	4.00
Industry group not specified	1.39	1.59	1.32	1.28	1.36	1.22	1.77	1.37	1.30	1.34	1.11	1.47
Manufacturing subdivided:												
Food and kindred products	2.25	3.05	3.97	2.13	3.60	3.76	3.84	3.07	1.39	2.49	3.40	3.31
Textile-mill products	.44	.73	.48	.35	1.08	.38	.16	.20	.01	.02	.03	.02
Apparel and other fabricated textile production	1.00	1.48	1.70	.40	.46	.60	.33	2.06	.03	.03	.14	.40
Logging	.03	.06	.02	.28	.31	.31	.03	.17	.01	.13	.01	.03
Sawmills and planing mills	.25	.51	.21	.40	1.04	.39	.49	.52	.02	.36	.07	.11
Furniture, store fixtures, and miscellaneous wooden goods	.86	1.69	1.18	1.25	1.25	.46	.35	.59	.03	.05	.19	.22
Paper and allied products	.97	.55	.74	1.10	2.07	.53	.11	.45	0	.01	.07	.19
Printing, publishing, and allied industries	1.73	1.26	2.58	1.26	1.34	1.45	1.19	1.49	.59	.76	1.16	1.31
Chemicals and allied products	1.16	.73	1.05	1.04	.40	.40	.33	.85	.02	.09	.18	.46
Petroleum and coal products	.37	.70	.54	.18	.06	.08	.03	.27	.03	.05	.08	.90
Leather and leather products	.73	.27	.99	.27	1.74	.14	.09	2.56	.01	.03	.06	.03
Stone, glass, and clay products	2.16	1.40	.81	.51	.30	.55	.47	.79	.04	.14	.19	.33
Iron and steel and their products	8.76	6.27	4.74	3.46	2.84	1.04	.96	1.57	.04	.01	.25	.53
Nonferrous metals and their products	.81	.57	1.04	.73	.81	.20	.11	.36	.04	.05	.11	.16
Machinery	5.84	5.02	5.59	3.33	4.86	1.26	1.83	1.68	.14	.19	.44	.45
Automobiles and automobile equipment	1.90	3.03	.48	19.49	1.67	.25	.07	.80	.03	.01	.07	.12
Transportation equipment except automobiles	.41	.57	.38	.29	.24	.06	.05	.30	0	0	.05	.30
Manufacturing industry not specified	3.72	2.13	2.08	1.89	1.41	.60	.99	1.15	.07	.08	.37	.22

SOURCE: *Census of Population*, 1940.

TABLE 3.—*Percentage distribution among industry groups of employed persons in the United States and each State, 1940*—Continued

	Division								
	South Atlantic								
	Delaware	Maryland	District Columbia	Virginia	West Virginia	North Carolina	South Carolina	Georgia	Florida
All industries—percent of United States total	0.23	1.53	0.68	2.07	1.15	2.68	1.46	2.45	1.51
Industrial groups—percent of each area total:									
Agriculture	13.71	9.92	.17	23.87	15.28	33.58	39.45	33.91	17.09
Forestry and fishing	.17	.61	.01	.74	.06	.26	.16	1.22	1.83
Coal mining	0	.41	0	2.15	20.40	.01	0	.02	0
Oil and gas wells	.01	0	0	0	1.06	0	0	0	.01
Other mines and quarries	.09	.17	.03	.43	.38	.23	.20	.34	.37
Construction	6.79	5.69	6.39	5.20	3.99	3.89	3.38	3.76	6.40
Manufacturing	28.88	26.12	7.20	20.11	17.64	26.93	22.83	18.53	11.73
Transportation, communication, etc	7.71	8.45	6.84	6.87	7.54	3.40	2.90	4.71	6.65
Trade	18.86	21.77	23.46	15.69	15.13	12.87	11.48	14.63	25.24
Wholesale and retail trade	14.36	16.61	17.02	12.39	12.40	10.48	9.36	11.71	20.37
Finance, insurance, and real estate	2.80	3.36	4.73	2.03	1.42	1.28	1.22	1.75	3.04
Business and repair services	1.70	1.80	1.71	1.27	1.31	1.11	.90	1.17	1.83
Personal services	10.32	10.01	15.17	10.11	7.17	9.55	10.76	12.89	17.07
Professional services	7.19	8.11	10.54	6.47	7.39	5.74	5.35	5.47	7.94
Amusement, recreation, etc	.64	.89	.88	.53	.57	.47	.39	.50	1.45
Professional and related services	6.55	7.22	9.66	5.94	6.82	5.27	4.96	4.97	6.49
Government	3.75	6.66	28.97	7.07	2.59	2.23	2.62	3.42	4.16
Industry group not specified	2.51	2.08	1.21	1.29	1.39	1.30	.87	1.09	1.51
Manufacturing subdivided:									
Food and kindred products	2.47	3.33	1.03	1.69	1.08	1.12	.89	1.64	2.38
Textile-mill products	3.18	.83	.02	3.25	.68	15.72	15.20	7.66	.06
Apparel and other fabricated textile production	1.93	3.37	.05	1.05	.39	.52	.36	1.48	.15
Logging	.06	.09	0	.44	.73	.51	.53	.40	.92
Sawmills and planing mills	.68	46	.04	2.30	1.43	2.27	2.38	2.24	2.19
Furniture, store fixtures, and miscellaneous wooden goods	.92	.60	.09	1.32	.26	2.02	.56	.70	.95
Paper and allied products	.25	.58	.10	.77	.36	.43	.43	.38	.47
Printing, publishing, and allied industries	.79	1.59	3.08	.76	.59	.45	.33	.59	.92
Chemicals and allied products	9.03	2.34	.10	2.21	2.92	.76	.65	1.07	.70
Petroleum and coal products	.53	.39	.02	.07	.33	.02	.04	.09	.05
Leather and leather products	2.40	.63	.01	.60	.31	.11	.01	.25	.02
Stone, glass, and clay products	.23	.80	.19	.49	3.32	.35	.31	.51	.32
Iron and steel and their products	1.92	4.96	1.97	.54	3.59	.18	.09	.49	.21
Nonferrous metals and their products	.22	.59	.07	.10	.46	.12	.02	.08	.07
Machinery	.60	1.24	.19	.21	.46	.24	.16	.39	.24
Automobiles and automobile equipment	.11	.42	.03	.16	.02	.07	.03	.24	.07
Transportation equipment except automobiles	1.86	2.50	.04	2.19	.15	.04	.50	.03	.39
Manufacturing industry not specified	1.72	1.40	.16	1.96	.58	2.01	.36	.31	1.63

	Division							
	East South Central				West South Central			
	Kentucky	Tennessee	Alabama	Mississippi	Arkansas	Louisiana	Oklahoma	Texas
All industries—percent of United States total	1.88	2.09	1.98	1.61	1.29	1.71	1.46	4.73
Industrial groups—percent of each area total:								
Agriculture	36.47	33.13	39.57	57.68	51.39	32.25	33.11	29.76
Forestry and fishing	.05	.11	.32	.35	.25	.96	.03	.13
Coal mining	6.45	1.01	2.58	0	.28	0	.23	.03
Oil and gas wells	.30	.01	.01	.18	.40	1.71	4.52	2.61
Other mines and quarries	.39	.51	.79	.08	.33	.21	.56	.21
Construction	4.20	4.54	3.22	3.32	2.95	4.53	4.08	5.18
Manufacturing	11.89	18.31	17.39	9.18	9.88	12.85	7.70	9.90
Transportation, communication, etc	6.29	5.45	4.30	3.00	4.27	6.55	5.06	6.56
Trade	15.91	16.70	12.48	9.86	13.48	17.99	21.96	22.46
Wholesale and retail trade	12.55	13.34	10.06	8.20	11.01	14.60	17.24	17.83
Finance, insurance, and real estate	1.79	1.93	1.42	.81	1.22	1.94	2.58	2.63
Business and repair services	1.57	1.43	1.00	.85	1.25	1.45	2.14	2.00
Personal services	7.57	10.37	10.59	9.14	7.88	12.16	8.52	11.07
Professional services	6.10	6.21	5.22	4.56	5.39	6.79	8.69	7.24
Amusement, recreation, etc	.56	.47	.37	.31	.50	.77	.83	.77
Professional and related services	5.54	5.74	4.85	4.25	4.89	6.02	7.86	6.47
Government	3.07	2.47	2.39	1.69	2.18	2.97	3.86	3.70
Industry group not specified	1.29	1.16	1.13	.96	1.33	1.00	1.66	1.16
Manufacturing sub-divided:								
Food and kindred products	2.13	1.72	1.14	1.10	1.07	2.70	1.84	1.94
Textile-mill products	.41	3.97	5.00	.74	.15	.36	.14	.35
Apparel and other fabricated textile production	.98	1.51	.40	.99	.26	.49	.09	.50
Logging	.23	.35	.44	.63	1.07	.70	.27	.24
Sawmills and planing mills	.93	1.70	3.05	3.25	4.33	2.61	.53	.99
Furniture, store fixtures, and miscellaneous wooden goods	.74	.98	.29	.48	.87	.51	.24	.43
Paper and allied products	.10	.26	.41	.24	.41	1.04	.04	.13
Printing, publishing, and allied industries	.87	.87	.44	.26	.45	.61	.95	.86
Chemicals and allied products	.30	1.88	.66	.63	.30	.82	.20	.44
Petroleum and coal products	.23	.07	.19	.03	.20	1.09	1.43	1.74
Leather and leather products	.37	.66	.02	0	.01	.01	.01	.06
Stone, glass, and clay products	.41	.60	.46	.37	.26	.48	.44	.31
Iron and steel and their products	1.40	1.37	3.85	.05	.11	.34	.42	.40
Nonferrous metals and their products	.28	.65	.09	.02	.08	.09	.29	.18
Machinery	.90	.36	.27	.10	.13	.29	.54	.81
Automobiles and automobile equipment	.24	.27	.04	.02	.05	.06	.05	.14
Transportation equipment except automobiles	.06	.04	.26	.14	.01	.27	.04	.14
Manufacturing industry not specified	1.32	1.05	.37	.13	.15	.37	.18	.25

TABLE 3.—*Percentage distribution among industry groups of employed persons in the United States and each State, 1940*—Continued

	Division										
	Mountain								Pacific		
	Montana	Idaho	Wyoming	Colorado	New Mexico	Arizona	Utah	Nevada	Washington	Oregon	California
All industries—percent of United States total	0.41	0.35	0.19	0.77	0.31	0.33	0.33	0.09	1.35	0.86	5.59
Industrial groups—percent of each area total:											
Agriculture	31.84	36.65	29.39	21.03	32.01	21.53	19.17	15.26	13.74	18.30	10.51
Forestry and fishing	.37	.46	.17	.14	.20	.21	.22	.14	.82	.53	.29
Coal mining	.84	.02	4.78	2.21	1.61	.02	1.49	0	.43	.01	0
Oil and gas wells	.43	.02	2.04	.09	2.20	.03	.04	.02	.01	.01	.97
Other mines and quarries	6.02	4.21	.44	2.24	2.49	8.47	5.26	15.08	.45	.74	.84
Construction	4.76	4.53	4.79	5.11	5.96	5.88	5.40	7.37	6.16	5.31	6.01
Manufacturing	7.41	7.92	5.32	10.17	6.40	8.39	10.96	4.50	21.56	20.93	16.51
Transportation, communication, etc	8.02	6.57	10.39	8.29	6.63	7.52	10.47	12.46	8.18	7.90	7.91
Trade	19.80	20.17	17.81	25.17	18.92	22.39	24.61	20.21	24.94	21.29	29.26
Wholesale and retail trade	15.80	16.36	14.26	19.26	15.42	18.30	19.41	16.43	19.11	18.91	21.84
Finance, insurance, and real estate	1.90	1.69	1.48	3.31	1.41	1.98	2.96	1.64	3.53	3.01	4.73
Business and repair services	2.10	2.12	2.07	2.60	2.09	2.11	2.24	2.14	2.30	2.37	2.69
Personal services	6.01	6.04	6.49	8.38	8.16	9.53	6.05	8.04	7.33	7.60	9.50
Professional services	8.42	8.29	8.45	10.35	9.26	9.82	9.91	9.42	8.79	8.97	11.00
Amusement, recreation, etc	.79	.93	.79	.89	.73	1.11	.99	2.67	.94	.96	2.41
Professional and related services	7.63	7.36	7.66	9.46	8.53	8.71	8.92	6.75	7.85	8.01	8.59
Government	4.78	3.55	8.82	5.15	4.47	4.82	4.88	5.53	5.94	3.84	5.91
Industry group not specified	1.28	1.56	1.11	1.67	1.70	1.38	1.55	1.96	1.36	1.58	1.28
Manufacturing sub-divided:											
Food and kindred products	1.50	1.89	1.22	2.79	.81	1.53	2.94	.97	2.75	2.48	3.07
Textile-mill products	.02	.02	.01	.05	1.43	1.56	.50	.01	.12	.62	.24
Apparel and other fabricated textile production	.04	.04	.03	.20	.04	.03	.41	.04	.37	.38	.93
Logging	.55	1.30	.28	.12	.23	.34	.05	.03	3.52	4.06	.19
Sawmills and planing mills	1.21	2.26	.48	.32	1.00	.89	.21	.23	5.71	7.15	.73
Furniture, store fixtures, and miscellaneous wooden goods	.09	.12	.15	.21	.16	.41	.23	.06	.85	1.15	.73
Paper and allied products	.01	.01	0	.10	0	.01	.08	.01	1.58	.92	.31
Printing, publishing, and allied industries	.85	.89	.74	1.24	.62	.92	1.32	.77	1.29	1.31	1.59
Chemicals and allied products	.04	.03	.03	.29	.22	.26	.36	.15	.31	.21	.71
Petroleum and coal products	.42	.07	1.72	.18	.20	.02	.36	.02	.06	.06	.87
Leather and leather products	.02	.02	.02	.12	.02	.04	.04	.02	.05	.08	.14
Stone, glass, and clay products	.11	.15	.26	.47	.41	.22	.43	.14	.34	.25	.62
Iron and steel and their products	.12	.06	.06	1.98	.08	.22	.77	.04	.84	.73	1.36
Nonferrous metals and their products	2.08	.50	.04	.32	.69	1.48	2.44	1.78	.39	.17	.34
Machinery	.20	.23	.17	.55	.12	.24	.34	.11	.53	.58	1.28
Automobiles and automobile equipment	.02	.02	.01	.12	.01	.04	.07	.02	.13	.12	.50
Transportation equipment except automobiles	.01	.13	.04	.02	.02	.02	.02	.01	2.33	.13	2.01
Manufacturing industry not specified	.11	.17	.06	1.08	.33	.18	.38	.09	.39	.51	.89

Figure 44 shows the distribution of the ten and one-half million gainful workers engaged in agriculture at the time of the *Census of Population* in 1930. A large proportion of the Nation's farmers were located in the Southern States while greatest densities of agricultural workers per square mile were found in some of the bottom lands of the Mississippi River in Arkansas and Southern Louisiana, and around large urban centers.

The uneven distribution of agricultural employment and the extent of concentration in particular areas are indicated in tables 2 and 3. Those employed in agriculture were concentrated in 7 States, shown in the accompanying tabulation, which included only 17 percent of the total labor force:

State	Percentage of workers in U. S. agriculture		Percentage of workers in all U. S. industries	
	Percent	Rank	Percent	Rank
Texas	7.6	1	4.7	6
Mississippi	5.0	2	1.6	22
North Carolina	4.9	3	2.7	11
Georgia	4.5	4	2.5	13
Alabama	4.2	5	2.0	18
Tennessee	3.7	6	2.1	15
Iowa	3.7	7	1.9	19
Total	33.6		17.5	

Agriculture plays a strikingly important role in the economies of some States. Whereas in the country as a whole 18.5 percent of all workers specialized in agriculture, in 1940, the proportion for Mississippi was as high as 57.7 percent, North Dakota 53.4 percent, Arkansas 51.4 percent, South Dakota 48.1 percent, and Alabama 39.6 percent. The States with proportions higher than the national average are indicated in figure 45. Rhode Island is at the opposite extreme with only 1.9 percent of its workers devoted to agriculture, followed by Massachusetts with 2.3 percent and New Jersey with 3.1 percent.

The distribution of agricultural production among various products unfortunately cannot be measured in terms of the composition of the agricultural labor force with currently available data. The chief regionalized types-of-farming in the United States are shown in figure 46, adapted from two classifications of regions by the Bureau of Agricultural Economics.[6] In addition to relative income by type-of-farming, the BAE considered these factors: variation in soils, climate and surface features, crop and livestock combinations, rela-

[6] See map "Type of Farming Areas in the U. S. 1930," prepared by Bureau of Census in cooperation with the BAE. *A Geographic Summary of American Agriculture Based Largely on the Census,* Misc. Pub. No. 105, Figure 1.

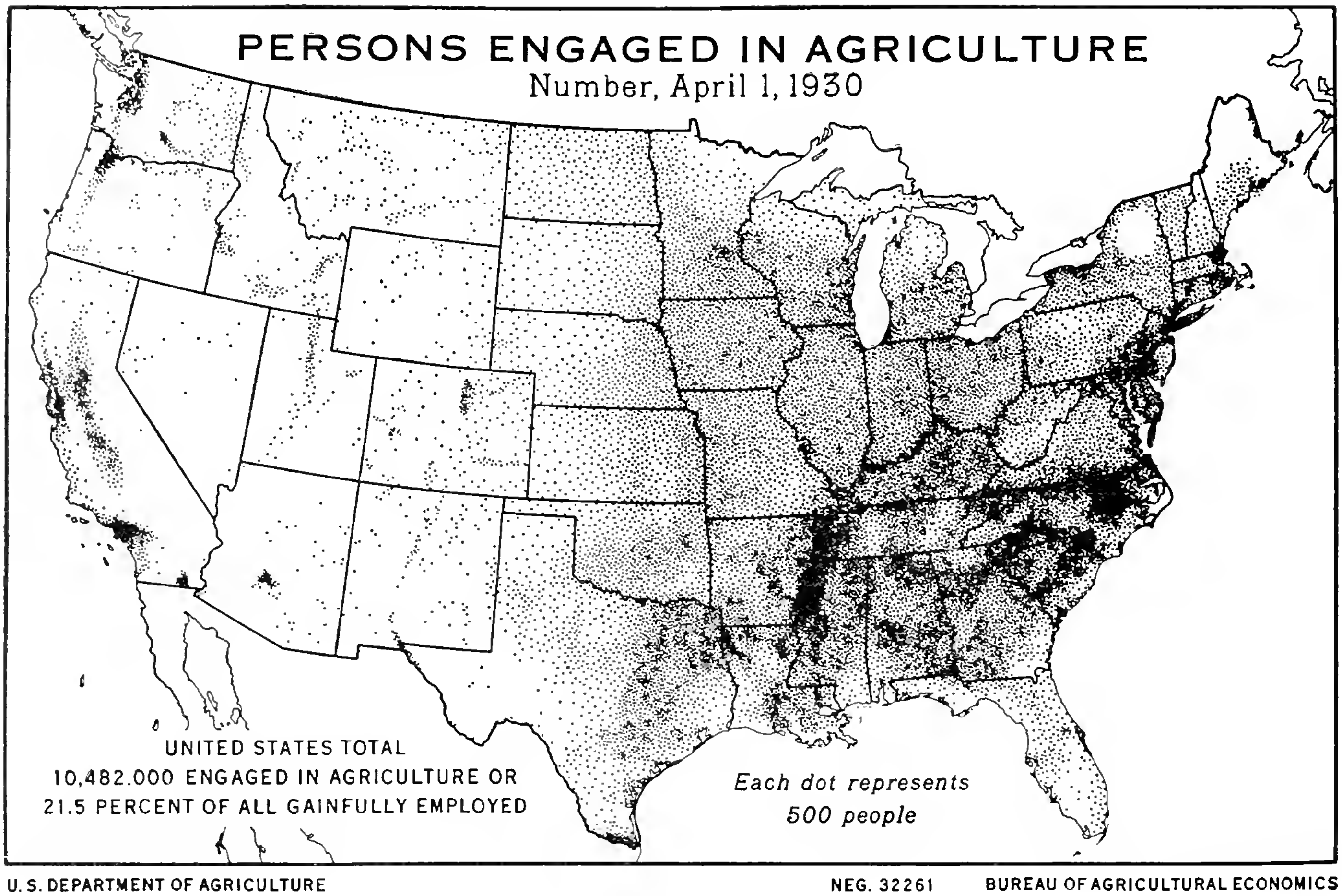


FIGURE 44

tive productivity, market locations, and other minor factors.

A somewhat more precise picture of regional specialization in particular types of farming can be obtained from data on value of farm produce gathered by the agricultural census. Table 4 shows the distribution in 1939 of total value of produce in each State and in the United States among 10 types of products. Each farm was classified according to its major source of income. If 2 or more of the 10 value of products groups were exactly equal the farm was classified according to the item predominating as major source of income in that locality.

For the United States as a whole, the largest proportion of total value of produce, nearly 39 percent, was attributed to field crops, followed by 24 percent in livestock and 16 percent in dairy products. Forest products had the lowest percentage of 0.3. Among the States, the highest proportions from any one source occurred in field crops which accounted for as much as 81 percent in South Carolina and 77 percent in North Carolina (cotton) and in dairy products with 78 percent in Vermont. No State had as diversified agricultural production as the United States as a whole; only three States, namely, California, Michigan, and Oregon, had less than 30 percent of total value of farm produce attributed to one source, while 21 States derived at least 50 percent from one source.

While development of particular types of farming in an area is conditioned by natural attributes, including soils, climate, topography, etc., the use of the land is affected also by the pressure of economic forces. Here it is important to note how the proximity of manufacturing activity and the urbanization of an area can affect the nature of agricultural production. The operation of this "market" factor is exemplified in the agricultural pattern developed in the Northeast region of the United States, which is predominantly a manufacturing area but which has some land above the national average in productivity and which accounts for roughly 20 percent of all gainful workers in agriculture. The farms of this area specialize for the most part in the production of bulky or perishable products such as dairy products, vegetables, small fruits, poultry, eggs, and so forth. Figure 46 reveals a belt of such specialized farming stretching in the North from central

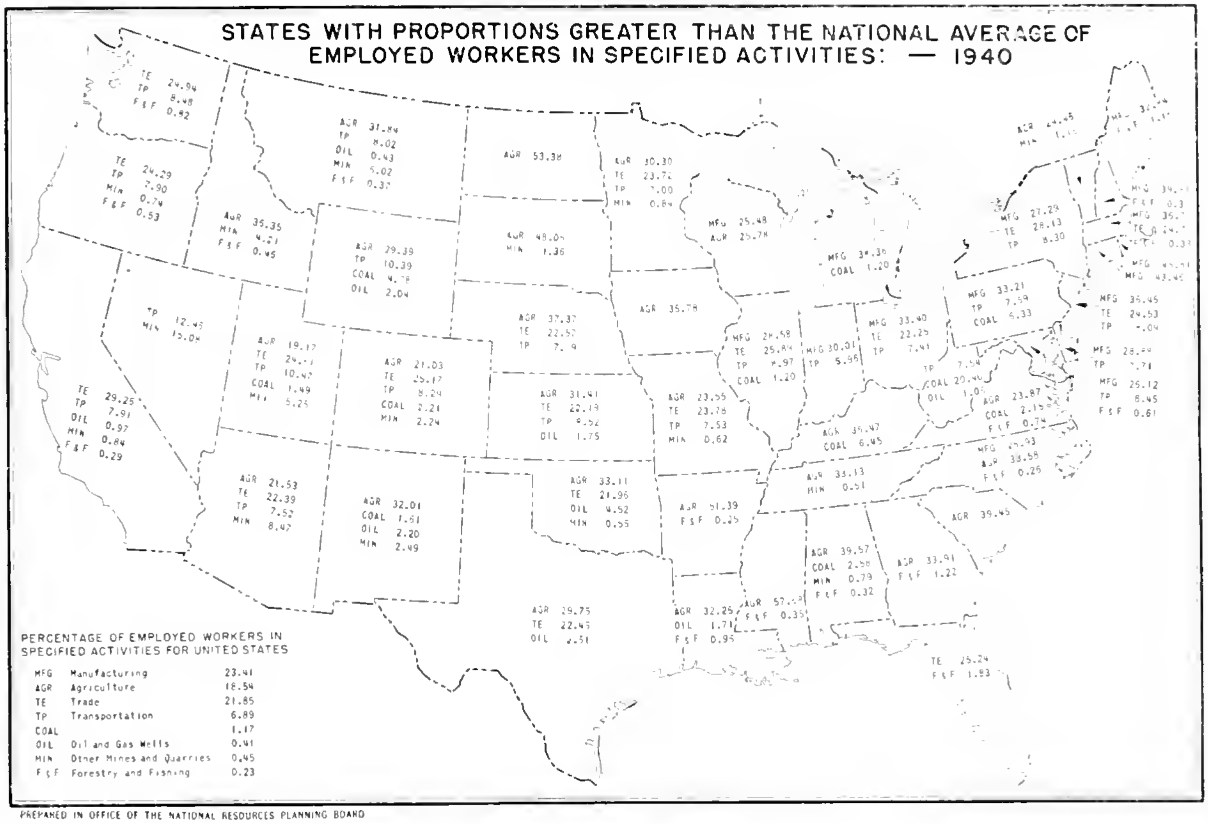


FIGURE 45

Minnesota to the Atlantic coast. Similar specialization occurs around other urban areas.

While these areas had the resources necessary for dairying, truck farming, and poultry raising, specialization in this type of agriculture was determined not by resources alone but by the proximity of the manufacturing belt and the necessity of supplying fresh food products daily to large agglomerations of population. Every city has a similar supply area at its outskirts if physically possible, and in the Northeast, the predominantly urban character of the region has diverted almost its entire agricultural activity to this type of farming.

Other Extractive Industries

Even more than farming, the location of the extractive industries is determined by the location of the resources they exploit. The areas of the United States where mining is an important economic activity are indicated on figure 47. The concentration of extractive workers in the Appalachian region, around Birmingham, Ala., and in southern Illinois and southern Indiana is accounted for largely by the coal fields in these areas, while the Lake Superior region is an iron-mining area with copper on the northernmost peninsula. Areas of concentration in Oklahoma, Texas, and southern California are due primarily to the production of oil and gas while those in Montana, Arizona, and Utah indicate copper and other nonferrous metal mining. The nature of extractive activity in other areas indicated can be checked in detail against maps in Chapters 1 and 2 which show the location of mineral deposits.

The concentrated distribution of the extractive industries requires little explanation, since mineral deposits can be worked only where they exist and they exist in relatively few locations. The degree of exploitation of these natural resources varies, however, with character of the deposits and their proximity to market or processing plants.

In 1940 the employed workers engaged in coal mining constituted 1.2 percent of the Nation's total labor force, but in West Virginia the percentage reached 20.4, in Kentucky 6.5, and in Pennsylvania 6.3. The working force in oil and gas production amounted to only 0.4 percent of the national total, and the highest State percentages occurred in Oklahoma with 4.5, Texas with 2.6, and New Mexico with 2.2. In 21 States, less than one-tenth of 1 percent of all employed workers were engaged in coal mining and oil and gas wells combined. In other mines and quarries, the national proportion

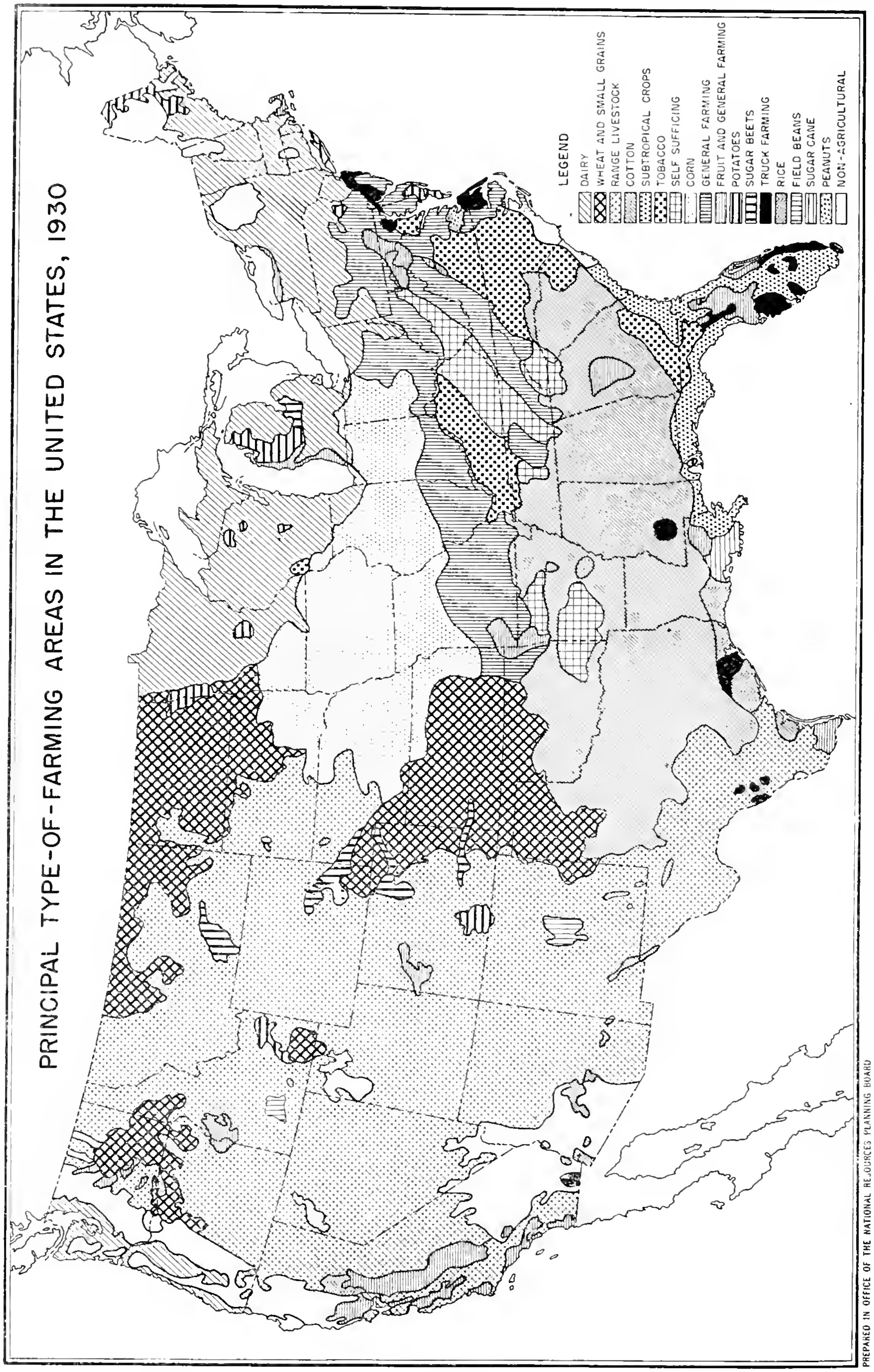

PRINCIPAL TYPE-OF-FARMING AREAS IN THE UNITED STATES, 1930
LEGEND
DAIRY
WHEAT AND SMALL GRAINS
RANGE LIVESTOCK
COTTON
SUBTROPICAL CROPS
TOBACCO
SELF SUFFICING
CORN
GENERAL FARMING
FRUIT AND GENERAL FARMING
POTATOES
SUGAR BEETS
TRUCK FARMING
RICE
FIELD BEANS
SUGAR CANE
PEANUTS
NON-AGRICULTURAL
PREPARED IN OFFICE OF THE NATIONAL RESOURCES PLANNING BOARD

FIGURE 46

TABLE 4.—*Value of farm products sold, traded, or used by farm households classified by major source of income, by States, 1939*

State	Major source of income groups—Percentage of total value of farm produce of State derived from—									
	Livestock	Dairy products	Poultry and poultry products	Other livestock products	Field crops	Vegetables harvested for sale	Fruits and nuts	Horticultural specialties sold	Forest products sold	Farm products used by farm households
United States	23.50	15.54	4.60	0.64	38.60	2.30	3.85	1.68	0.33	8.96
Alabama	4.5	5.1	1.4	.1	51.6	.8	.8	.8	.9	31.0
Arizona	37.2	7.8	2.3	1.8	38.2	5.9	2.2	.3	.1	4.2
Arkansas	4.7	2.9	2.4	.1	65.5	.4	2.1	.2	.5	21.2
California	11.9	16.3	8.8	.4	23.2	8.3	27.8	2.3	.1	.9
Colorado	46.7	6.6	3.1	.9	33.8	2.8	1.6	2.1	.1	2.3
Connecticut	2.0	40.3	21.1	.1	18.7	2.4	2.6	7.8	.3	4.7
Delaware	1.5	17.7	48.9	0	9.4	7.5	6.1	3.4	.2	5.3
Florida	5.2	10.2	4.3	.5	14.4	22.4	30.3	4.5	.4	7.8
Georgia	2.9	5.3	1.8	.1	66.9	1.0	3.0	.5	1.3	16.9
Idaho	28.0	9.3	1.5	.6	53.6	1.3	2.0	.4	.3	3.0
Illinois	28.7	8.6	1.5	.2	53.7	1.1	.9	2.1	0	3.2
Indiana	42.6	10.3	4.2	.2	31.9	1.8	.8	1.7	.2	6.3
Iowa	55.9	3.5	1.6	.1	36.3	.2	.1	.6	0	1.7
Kansas	37.8	6.3	2.6	.1	47.4	.2	.4	.6	0	4.6
Kentucky	20.7	5.5	.9	.1	46.8	.4	.6	.6	.1	24.0
Louisiana	2.9	5.9	.4	.2	73.3	.8	3.3	.4	.3	12.5
Maine	2.8	22.6	11.7	.5	41.8	1.4	2.0	1.8	3.6	11.8
Maryland	5.3	31.5	12.2	.1	25.0	8.6	3.2	3.5	.3	7.3
Massachusetts	2.9	39.5	21.4	.3	7.1	5.2	8.3	9.9	.7	4.7
Michigan	14.9	29.9	4.9	.8	28.0	3.6	6.1	2.4	.3	9.1
Minnesota	27.3	22.5	3.7	.3	40.2	.6	.2	.8	.1	4.3
Mississippi	2.6	4.3	.6	.1	68.0	.9	.3	.3	.6	22.3
Missouri	42.4	8.3	3.8	.1	29.4	.5	.8	.9	.2	13.6
Montana	38.7	5.2	1.1	2.3	48.8	.3	.3	.4	.2	2.7
Nebraska	55.7	3.4	2.0	.1	34.5	.1	.2	.4	0	3.6
Nevada	66.1	11.2	3.3	4.2	12.2	.6	.1	.3	0	2.0
New Hampshire	4.1	39.7	29.2	.3	3.4	1.3	2.1	2.5	6.1	11.0
New Jersey	2.5	35.9	20.3	.1	9.8	15.6	4.7	9.3	0	1.8
New Mexico	48.5	4.6	.8	3.0	33.0	1.2	1.0	.2	.3	7.4
New York	3.0	54.7	10.6	.4	10.3	6.0	5.4	4.9	.4	4.3
North Carolina	1.2	3.5	1.5	.1	76.8	.7	.9	.4	.6	11.3
North Dakota	14.0	4.5	.9	.2	75.4	.1	0	.1	0	4.8
Ohio	31.7	18.2	6.2	.4	27.2	2.0	2.0	3.9	.2	8.2
Oklahoma	21.5	6.6	1.7	.1	55.1	.4	.6	.7	.1	73.2
Oregon	23.6	15.3	9.6	1.4	28.5	3.4	9.7	1.9	.7	5.9
Pennsylvania	7.2	39.9	13.3	.6	17.4	2.6	3.1	4.8	.4	10.7
Rhode Island	1.3	56.5	17.7	.1	6.7	3.0	2.2	7.8	.8	3.9
South Carolina	1.2	3.7	1.3	0	80.5	1.8	1.5	.3	.5	9.2
South Dakota	50.3	3.6	1.8	.7	39.4	.1	0	.4	0	3.7
Tennessee	16.0	8.1	.8	.1	40.2	.7	1.1	.9	.6	31.5
Texas	28.2	5.8	2.3	3.4	47.4	1.8	1.5	.7	.1	8.8
Utah	33.4	9.4	12.2	4.7	29.9	2.6	3.0	.9	0	3.9
Vermont	3.7	77.9	4.5	.7	2.6	.3	1.5	.8	2.8	5.2
Virginia	13.8	9.5	8.4	.1	32.5	2.8	3.7	1.4	1.4	26.4
Washington	9.3	18.6	9.6	.7	34.1	3.2	16.2	2.1	.3	5.6
West Virginia	20.6	11.1	4.9	.3	4.6	.5	4.2	1.1	1.1	51.6
Wisconsin	13.1	70.9	2.0	1.5	6.0	.9	.8	1.0	.3	3.5
Wyoming	67.8	4.2	1.1	6.1	18.2	.1	0	.1	.1	2.3

DEFINITIONS

Livestock and livestock products.—Includes domestic animals such as horses, mules, cattle, swine, sheep and goats, and excludes poultry, bees, and fur animals and production from these.

Other livestock products.—Includes wool, mohair, meat, hides, bees, honey, wax, goat milk and products, and fur animals sold or traded.

Field crops.—Includes items such as corn, soybeans, small grains, annual legumes, hay, clover and grass seeds, and miscellaneous crops including Irish potatoes, sweetpotatoes, cotton, tobacco, sugarcane, sugar beets, broomcorn, popcorn, mint, hops, etc., and byproducts such as cottonseed, beet pulp and tops, pea vines, etc.

Vegetable for sale.—Includes all vegetable crops.

Fruit and nuts.—Includes all tree fruits, nuts and grapes, small fruits and citrus, and excluding wild fruits except wild blueberries where land was used primarily for their production. Wild or seedling pecans are included whether grown in orchards, farmyards, pastures, and elsewhere on farm or ranch.

Horticultural specialties.—Includes crops grown under glass, propagated mushrooms, nursery products and flower and vegetable seeds, bulks, and flowers and plants grown in the open.

Farm products used by farm households.—Includes products of farm consumed by operator's family whether living on farm or not and by all households on farm, and excludes products of institutional farms used by inmates.

Forest products.—Includes firewood, fuel wood, standing timber, saw tops, veneer logs, pulpwood, mine props, tanbark, charcoal, fence posts, railroad ties, pales and piling turpentine, resin, maple syrup and sugar, etc.

SOURCE: *Census of Agriculture*, 1939.

was 0.5 percent of all employed workers, while in Nevada the proportion was as high as 15.1, in Arizona 8.5, and in Montana 6.0 percent.

Forestry and fishing[7] engaged only 0.2 percent of all employed workers in 1940, while in Florida the percentage was 1.8, in Georgia and Maine 1.2, and in Louisiana 1.0. Six States, namely Georgia, Florida, California, Louisiana, Virginia, and Massachusetts, accounted for half the national total.

[7] At this writing, no separate data on the distribution of employed workers in forestry and fishing are available.

Manufacturing

While the geographical distribution of extractive industry is determined largely by the location of physical resources, the location of manufacturing as a whole is dominated by no single factor. Some manufacturing industries are "material-oriented" and the problem of location is limited by a choice between possible sources of supply of the requisite factors of production. The processing of minerals and of perishable agricultural products thus generally takes place close to the resources and is concentrated or scattered depending

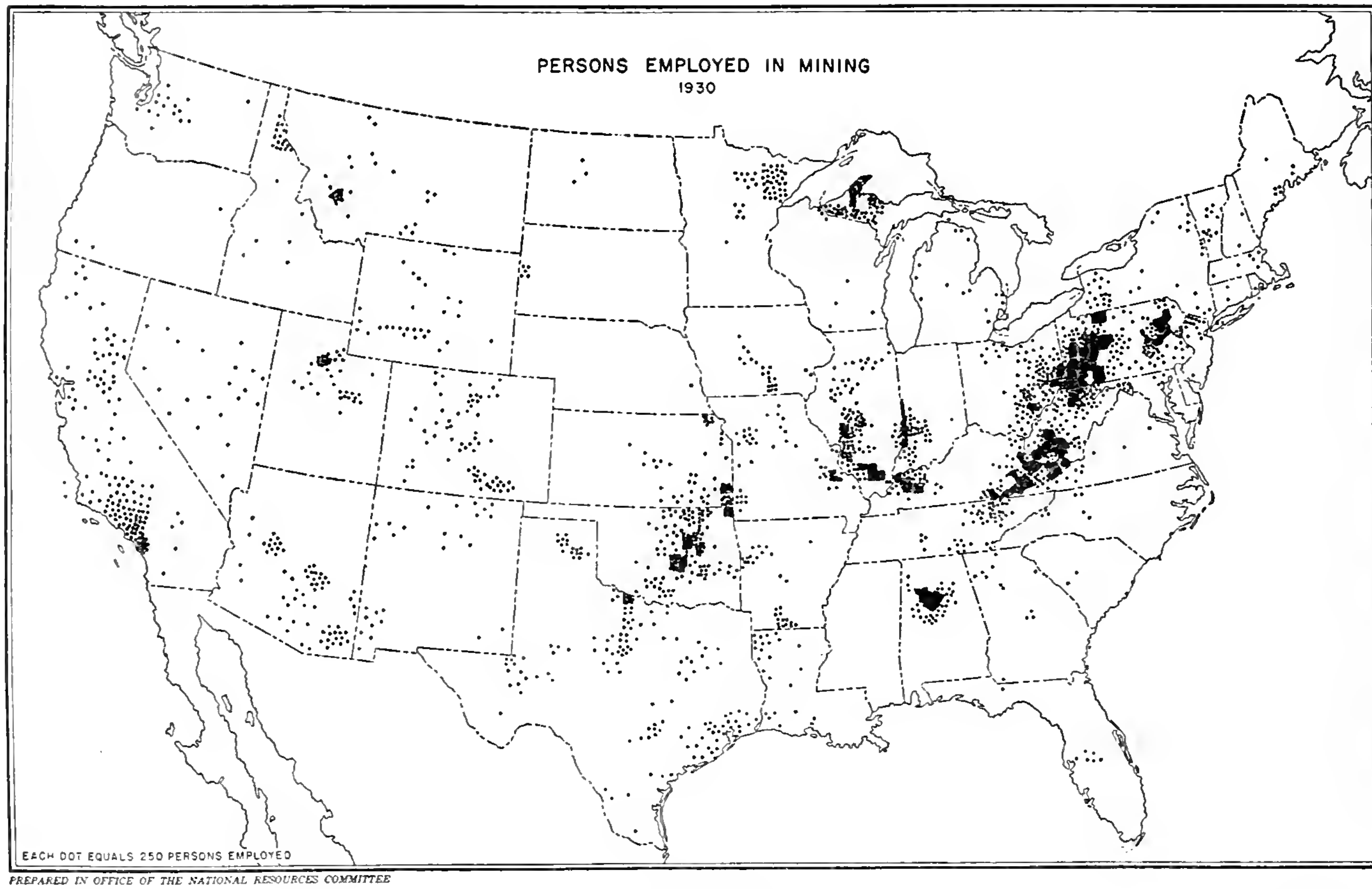


FIGURE 47

Source: Bureau of the Census.

on the distribution of the resources. At the other extreme are manufactures such as bread and bakery products and ice, which are "consumer-oriented," and are thus distributed in much the same manner as population, modified by relative consumer income.

The major part of manufacturing, however, is directly tied to neither raw materials nor the ultimate consumer. The industries in this third category are largely responsible for the highly uneven geographic distribution of manufacturing activity (fig. 48). Three general areas of concentration are evident, the greatest extending from the western shore of Lake Michigan to the Atlantic coast and southward to the Ohio and Potomac Rivers. The second cluster occurs in the southern Piedmont, and the third includes the large metropolitan regions along the Pacific coast. A more detailed picture of the concentration in manufacturing employment is presented in Figure 49, which shows the distribution of wage earners in the principal manufacturing counties of the United States in 1939.

Measured in terms of proportion of all gainful workers of a State, there is greater specialization in agriculture than in manufacturing. The proportion of employed workers in agriculture ranged from 3.0 percent in Rhode Island to 57.7 percent in Mississippi, and in manufacturing from 2.5 percent in North Dakota to 45.8 percent in Rhode Island. Two States, namely, Rhode Island and Massachusetts, had lower proportions in agriculture than any State had in manufacturing, while four States, namely, Arkansas, Mississippi, North Dakota, and South Dakota, had higher proportions engaged in agriculture than any State had in manufacturing. This difference in distribution between agriculture and manufacturing is shown graphically in figure 50. Here the proportions of total gainful workers in these activities in each State are shown by the vertical distance and are arranged horizontally in order of magnitude, clearly demonstrating the greater dispersion in the case of agriculture.

The distribution of manufacturing activity among the States and the specialization of particular areas in manufacturing can be derived from tables 2 and 3. More exact measures of concentration and specialization based on these data are developed in the following chapter. A rough indication of the distribution of manufacturing among the States is given in table 5, which shows for 1940 the percentages of total employed persons in all economic activity, in all manufacturing,

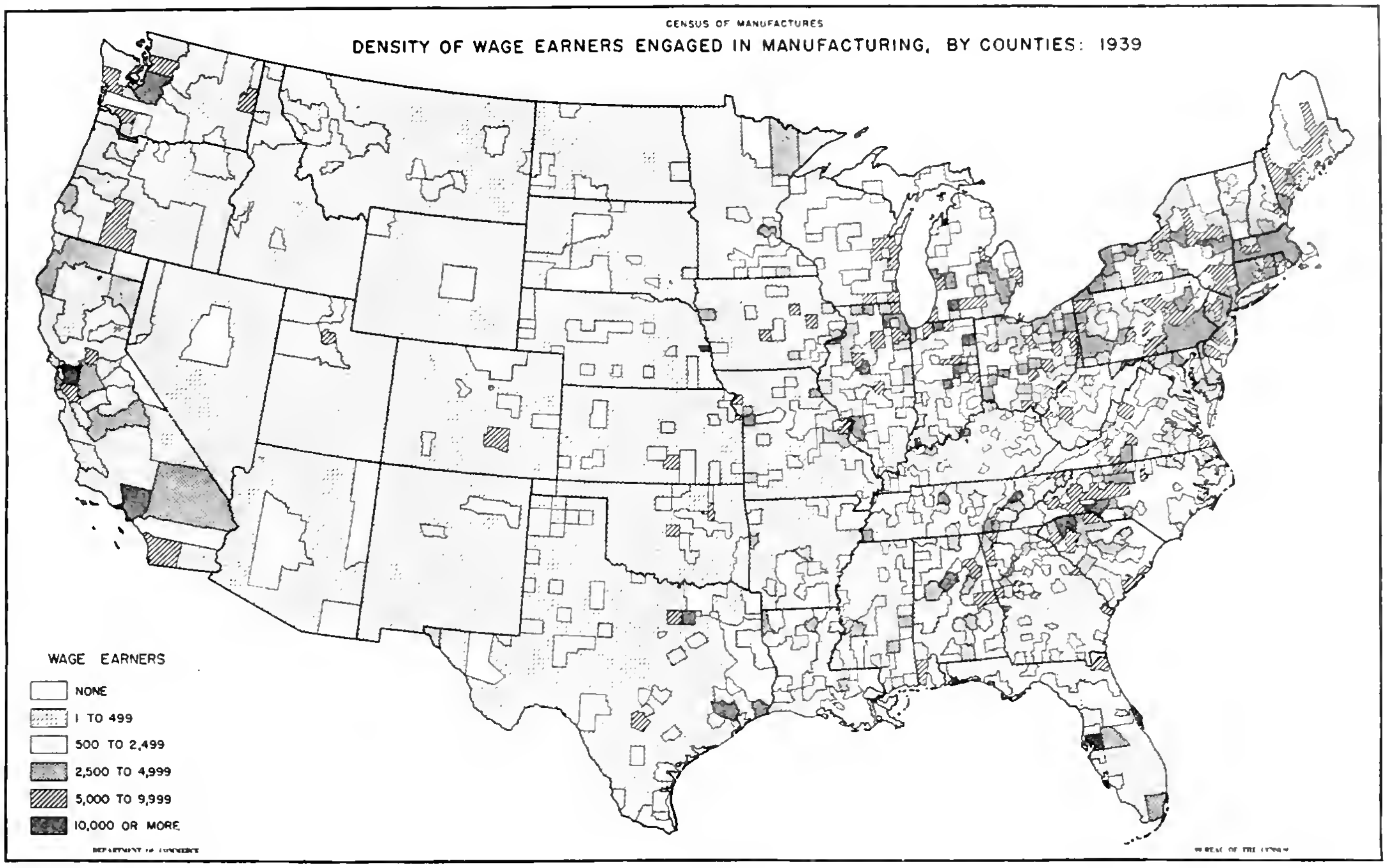


FIGURE 48

and in each of 18 groups of manufacturing included in the 7 States with the highest proportions of each.

Seven States, namely, New York, Pennsylvania, Illinois, California, Ohio, Texas, and Michigan, included 44 percent of all employed workers in the United States. The States having the 7 highest proportions of employed workers in manufacturing—substituting Massachusetts and New Jersey for Texas and California in the above list—have a total of 56 percent of all employed persons in manufacturing in the United States. Among the 18 subgroups of manufacturing activity, only 3 groups had less than 50 percent of the United States total located in the 7 ranking States, namely, food, logging, and saw and planing mills, all characterized by small establishments and wide markets; 13 of the subgroups had at least 55 percent of the total employed in the first 7 States, with a peak of 88 percent for automobiles and equipment. The latter group had 62 percent in the State of Michigan, while 1 other group, apparel, had 57 percent included in the first 3 States.

Services

Services deserve particular attention, first, because they engage more persons than agriculture and manufacturing combined, and second, because some are closely related to manufacturing activity. Industrial communities require a certain proportion of "residentiary services" on the spot and the adequacy of local services may influence plant location, while on the other hand the development of certain local services is strongly influenced by industrialization.

Services may be divided into two groups, those of most direct importance to the manufacturer, and those needed by the public generally. Construction and transportation facilities may be classed in the first group and trade, professional, public, and personal service in the second.

Although services are "consumer-oriented," their relative development among areas is affected by more than density of population alone. Owing to economies of centralization, variations in income patterns, and differences in industrial structure, services to consumers are frequently limited by local factors or performed at considerable distance from the population they serve.

Building

Roughly 2,056,000 persons were classified as builders and building contractors in 1940, representing 5

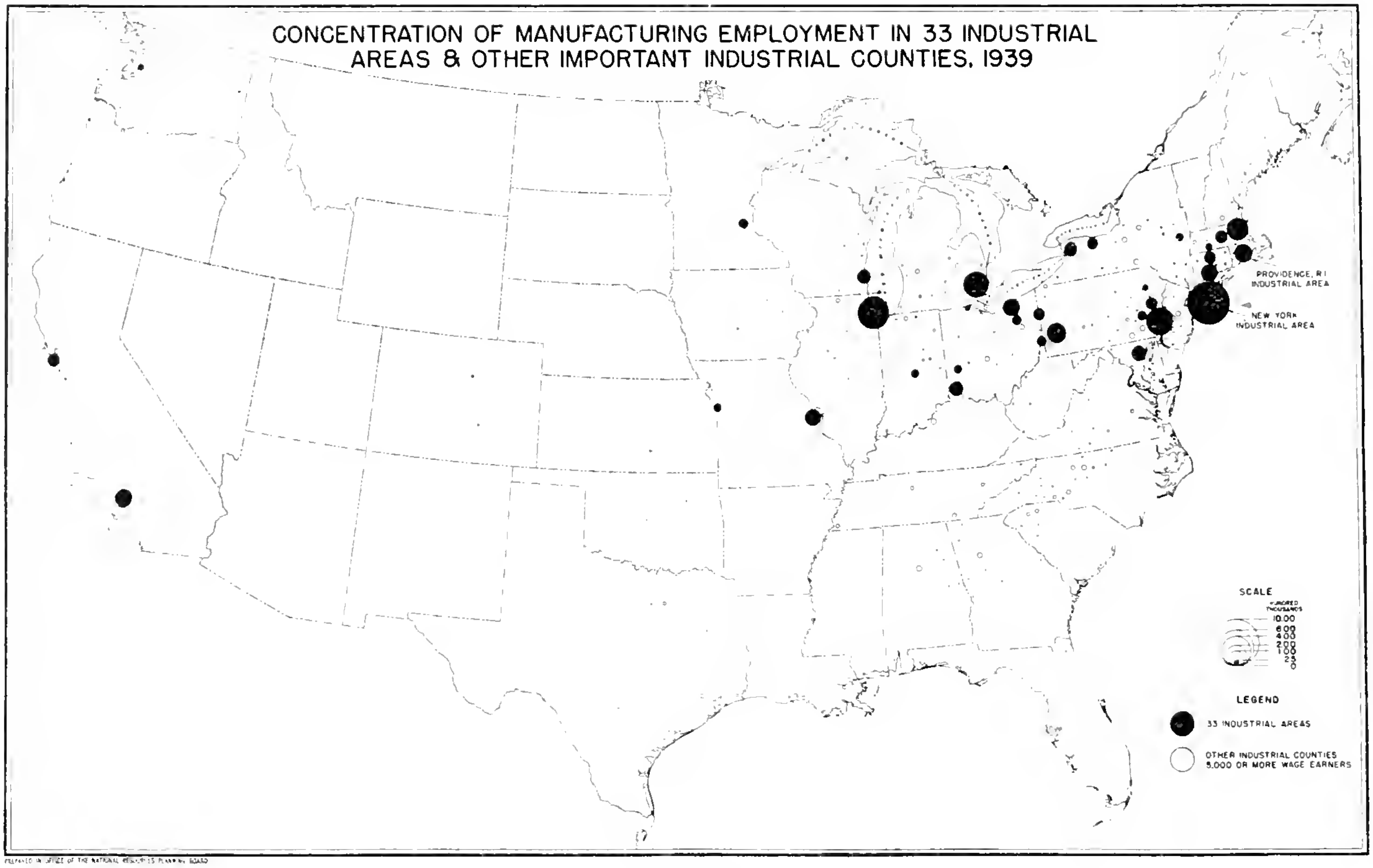


FIGURE 49

percent of the total labor force. The proportion of the total employed workers of each State in this branch of production ranged from 2.0 percent in North Dakota to 7.4 percent in Nevada. The more even distribution of building among the States than of either agriculture or manufacturing activity is illustrated in figure 50.

Clearly building must be performed at the point of consumption [8] and local activity in building is affected not only by population density but also by degree of industrialization. However, the States with the lowest proportions occur generally in the South which has a relatively dense population, reflecting still a third factor, namely, income pattern.

Transportation

Transportation, including communication services, accounted for 3,113,000 persons or 7 percent of the labor force in 1940. The more important subdivisions and the number of persons occupied were:

Railroads (including repair shops) and railway express service	1,135,000
Trucking service	428,000
Other transportation	615,000
Communication	393,000
Utilities	542,000

Employment was fairly evenly distributed in proportion to the gainfully occupied population, with a low of 2.9 percent in South Carolina and a median percentage of 6.6. The highest percentages were in Nevada (12.2) and Utah (10.5), both on transcontinental routes.

Trade

According to the 1940 *Census of Population*, 9,870,000 persons or 22 percent of all the gainful workers in the United States were engaged in trade, including:

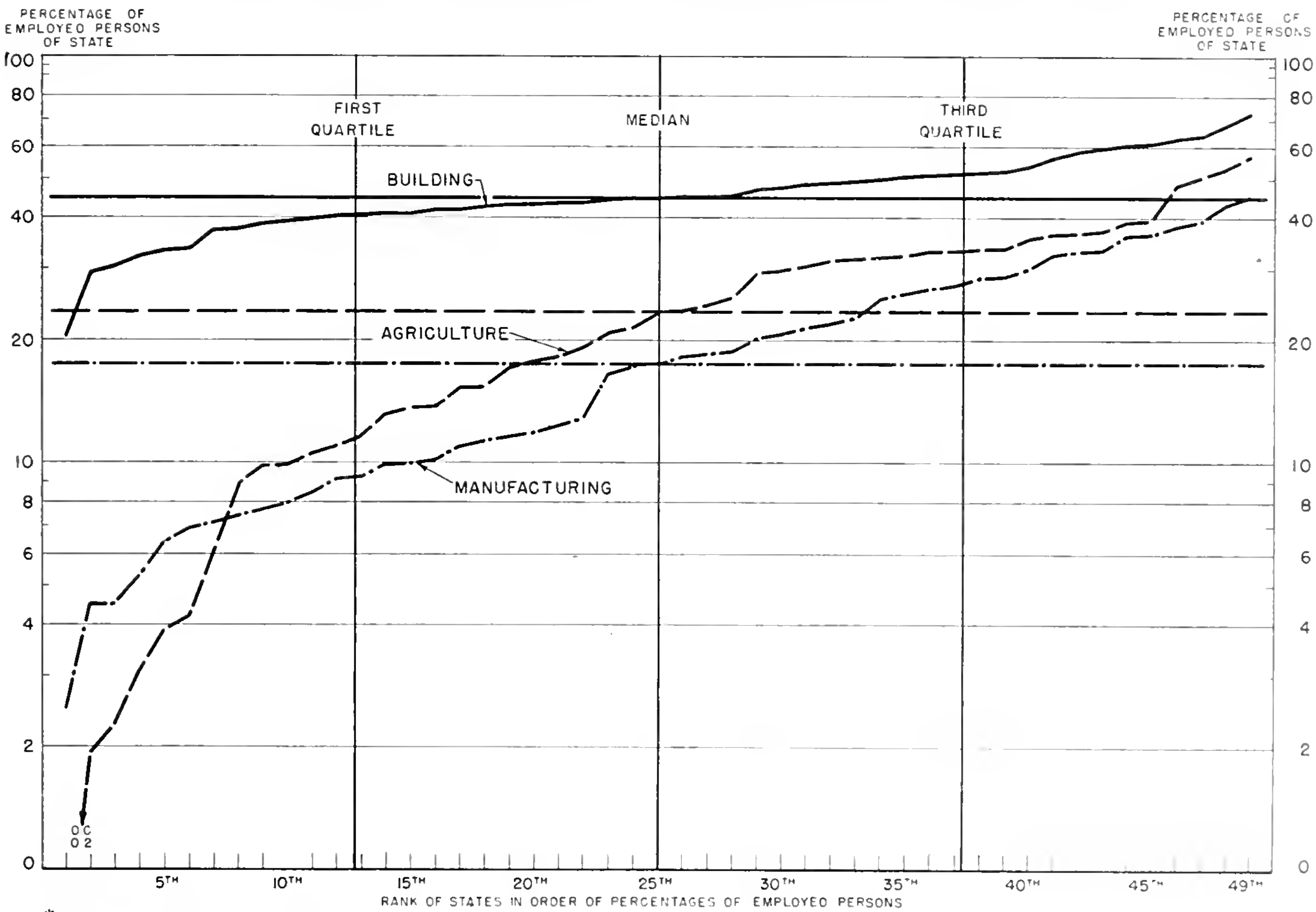
Wholesale trade	1,207,000
Food and dairy products stores, and milk retailing	1,489,000
Eating and drinking places	1,116,000
Motor vehicles and accessories retailing, and filling stations	739,000
Other retail trade	2,987,000
Finance, insurance, and real estate	1,468,000
Business and repair services	264,000

[8] Technological developments such as prefabrication, if widespread, may make possible centralization of construction activity by reducing the functions which must be performed on the spot.

TABLE 5.—*Percentage of total employed workers included in the 7 States with the highest percentages for each of 18 groups of manufacturing activity, 1940*

Manufacturing group	Highest		Second		Third		Cumulative total of first 3	Fourth		Fifth		Sixth		Seventh		Cumulative total of first 7
Food	N. Y.	10.95	Ill.	10.43	Pa.	7.41	28.79	Calif.	7.09	Ohio	4.83	Tex.	3.79	N. J.	3.66	48.16
Textiles	N. C.	16.24	Pa.	12.22	Mass.	10.85	39.31	N. Y.	8.75	S. C.	8.59	Ga.	7.25	N. J.	5.40	69.30
Apparel	N. Y.	36.31	Pa.	11.95	N. J.	8.42	56.68	Ill.	6.25	Mass.	4.16	Mo.	3.43	Calif.	3.00	73.52
Logging	Wash.	15.11	Oreg.	11.18	Fla.	4.42	30.71	Ark.	4.41	N. C.	4.34	Me.	4.27	La.	3.83	47.56
Sawmill and planing mill	Wash.	7.97	Oreg.	6.40	N. C.	6.30	20.67	Ala.	6.26	Ark.	5.80	Ga.	5.69	Miss.	5.42	43.84
Furniture and store fixtures	N. Y.	11.32	Ill.	9.38	N. C.	6.75	27.45	Mich.	6.33	Pa.	6.24	Ohio	5.60	Ind.	5.38	51.00
Paper	N. Y.	15.60	Mass.	8.82	Pa.	8.32	32.74	Ohio	6.92	Wis.	6.70	Ill.	6.47	Mich.	6.11	58.94
Printing	N. Y.	18.46	Ill.	11.76	Pa.	7.10	37.32	Ohio	6.43	Calif.	6.37	Mass.	4.67	N. J.	4.29	59.08
Chemicals	N. Y.	13.26	N. J.	11.76	Pa.	7.11	32.13	Ill.	6.39	Ohio	6.18	Va.	4.69	Mich.	4.33	54.79
Petroleum and coal	Tex.	18.47	Pa.	11.04	Calif.	10.88	40.39	N. J.	9.99	Ill.	7.72	N. Y.	6.48	Okla.	4.69	59.22
Leather	Mass.	19.26	N. Y.	18.77	Mo.	9.10	47.13	Pa.	7.84	Ill.	7.80	N. H.	5.96	Wis.	5.07	73.08
Stone, clay, and glass	Ohio	15.06	Pa.	14.88	N. Y.	8.60	38.54	Ill.	6.88	N. J.	6.46	W. Va.	5.12	Ind.	4.79	61.80
Iron and steel	Pa.	21.76	Ohio	16.27	Ill.	10.79	48.82	N. Y.	6.79	Ind.	5.72	Mich.	4.99	Conn.	3.97	70.29
Nonferrous metals	Conn.	15.12	N. Y.	14.19	Ill.	10.66	39.97	Pa.	8.42	Ohio	6.79	N. J.	6.18	Mass.	5.08	66.44
Machinery	Ill.	14.98	Ohio	12.77	N. Y.	11.99	39.74	Pa.	9.60	N. J.	6.72	Mass.	6.52	Md.	5.67	68.25
Automobiles and equipment	Mich.	61.87	Ohio	7.75	Ind.	6.06	75.68	N. Y.	4.42	Wis.	3.08	Pa.	2.89	Ill.	2.40	88.47
Transportation equipment, except automobiles	Calif.	16.59	N. Y.	12.31	Pa.	10.69	39.59	N. J.	10.02	Va.	6.69	Mass.	6.13	Md.	5.65	68.08
Others	N. Y.	18.76	Ohio	11.01	N. J.	8.66	38.43	Pa.	8.30	Ill.	7.56	Mass.	6.30	Conn.	4.90	65.49
All manufacturing	N. Y.	12.84	Pa.	10.15	Ill.	7.77	30.76	Ohio	7.41	Mich.	6.62	N. J.	5.41	Mass.	5.33	55.53
All gainful workers	N. Y.	11.01	Pa.	7.15	Ill.	6.36	24.52	Calif.	5.59	Ohio	5.19	Tex.	4.74	Mich.	4.04	44.08

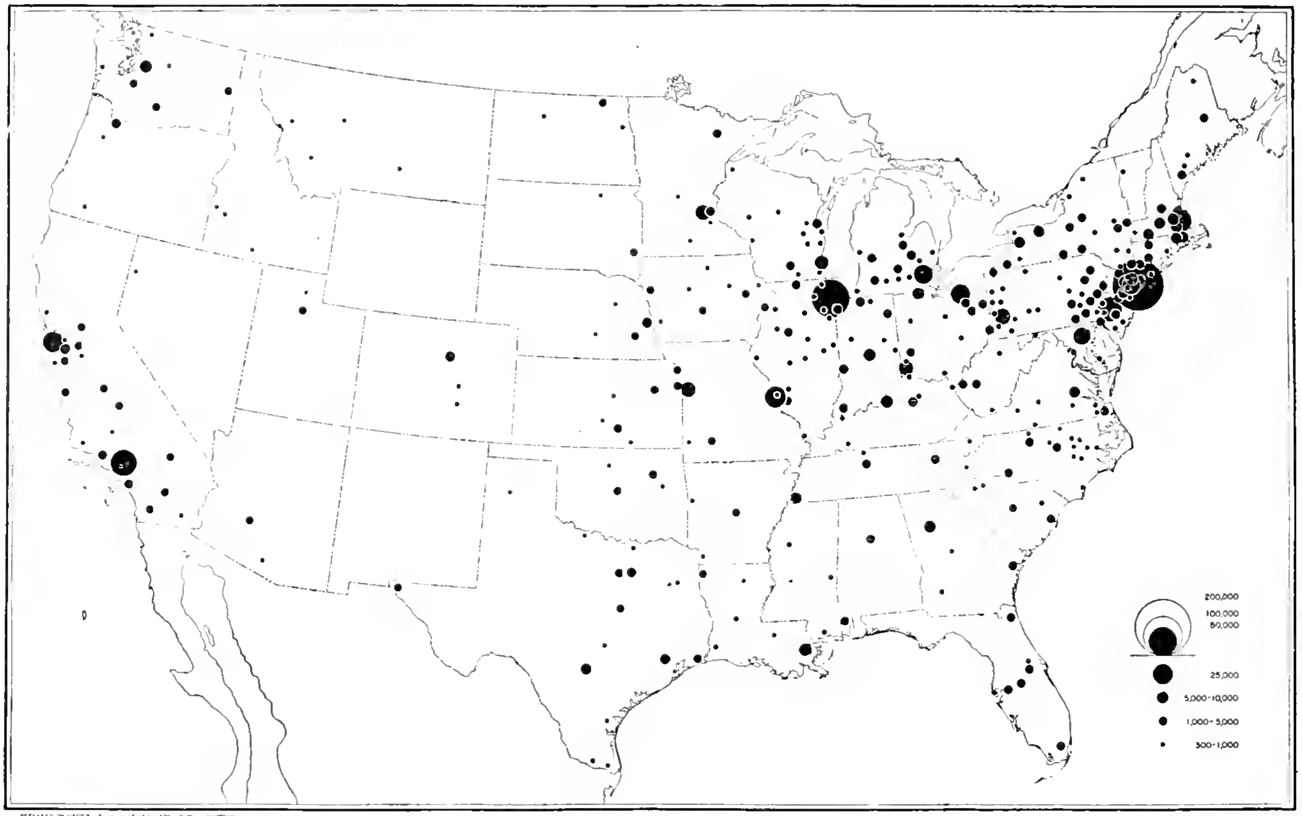
PERCENTAGE OF EMPLOYED PERSONS IN MANUFACTURING, AGRICULTURE, AND BUILDING* IN ORDER OF PERCENTAGE, BY STATES—1940



*BUILDING PERCENTAGES MULTIPLIED BY TEN

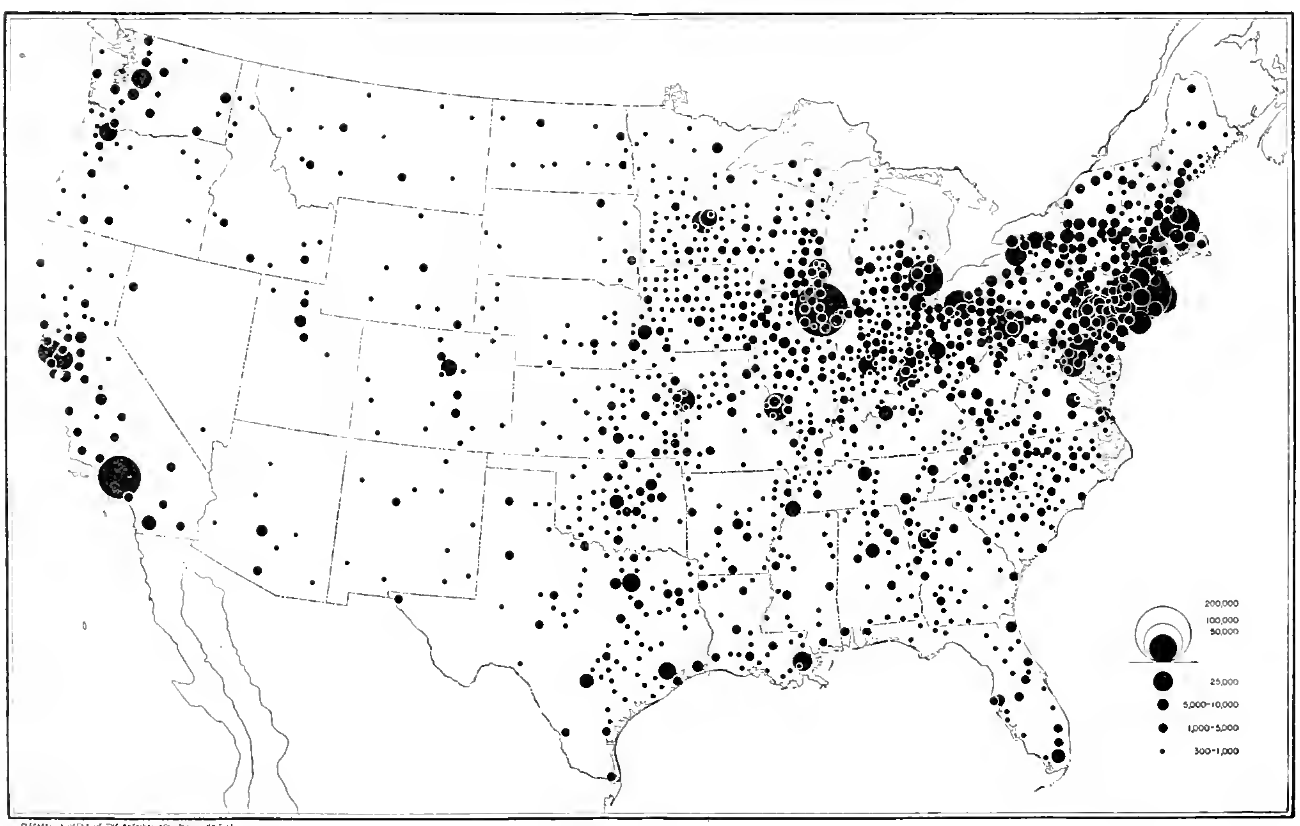
Source: Census of Population, 1940

FIGURE 50



Source: Census of Distribution, 1935.

FIGURE 51. Persons Employed in Wholesale Trade, 1935



Source: Census of Distribution, 1935.

FIGURE 52. Persons Employed in Retail Trade, 1935

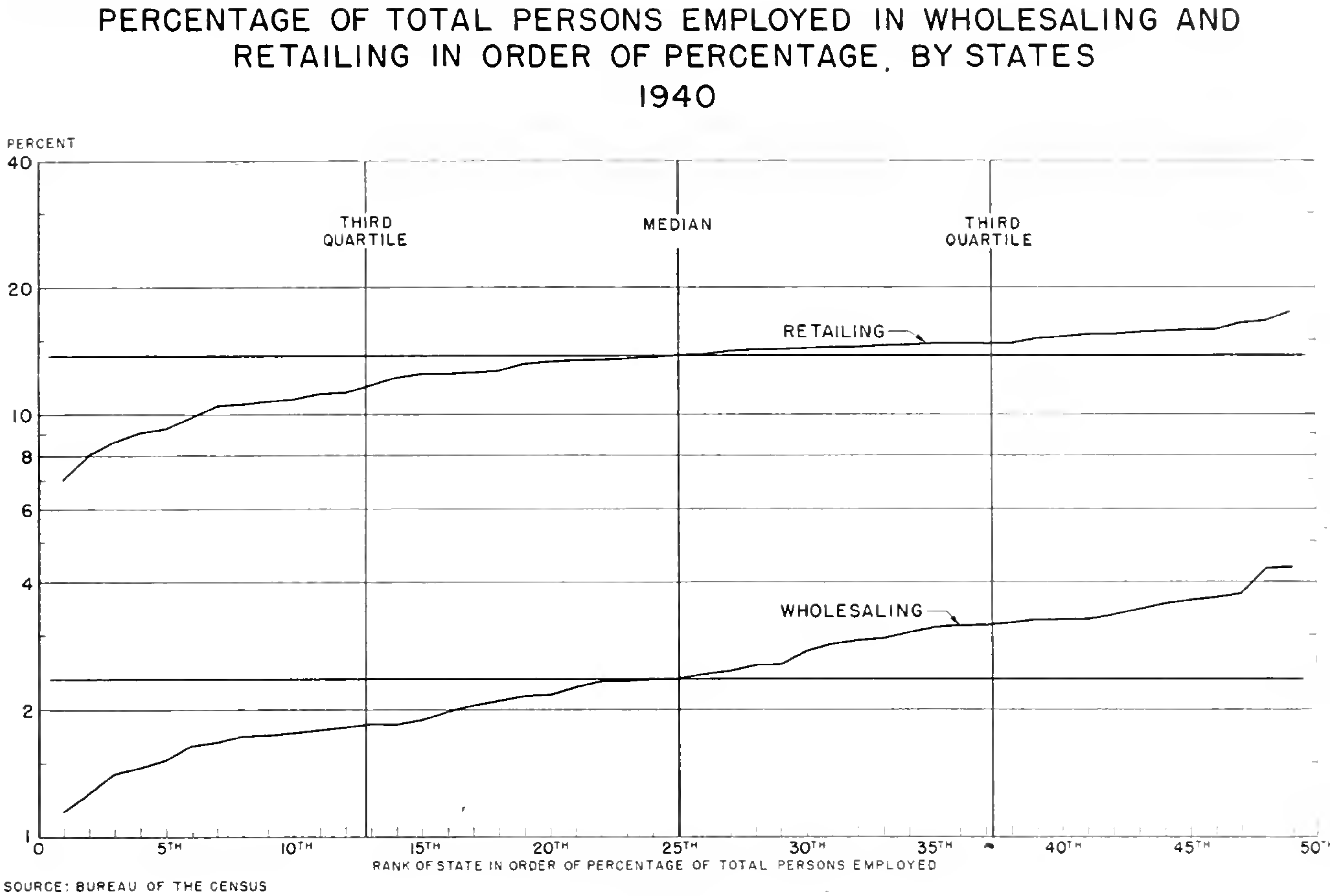


FIGURE 53

Trade as a whole tends to follow the population and its purchasing power. Some of the branches of trade shows highly uneven distributions, however, and are not "residentiary" in the sense that they need to locate within the immediate reach of the consumer. Wholesale trade [9] is highly concentrated in urban centers (see fig. 51), particularly in the Northeast and on the Pacific coast. Retail trade, on the other hand, follows the population much more closely. Comparison of figure 52 with figure 41 shows relatively less concentration of retailing than of population in the South, and suggests again curtailment of economic activity by low purchasing power.

Figure 53, in which the percentage of retailers and wholesalers to total employed persons in each State is shown by the vertical distance and the values are arranged horizontally in order of magnitude, illustrates graphically the differences between retail and wholesale distribution. When measured in terms of proportion of all gainful workers of a State, the incidence of retailing in the economies of most States is remarkably even.[10] The curve for wholesaling is steeper than that for retailing, rising sharply in the upper quartiles particularly, while the latter almost levels out in the center of the distribution.

Retailing is primarily a distributive service and must be located with regard to its widely dispersed consumers. Wholesaling, insurance, and banking are not only distributive services; they assemble and store as well. Thus, while there is a tendency toward dispersion in relation to the market, storing of funds and merchandise may often take place at some distance from the eventual customers. The wholesaler in one State may be storing goods for consumption in other States or (if he is an exporter) in other countries. This is also true of administrative work, e. g., recording and accounting, which are more important in wholesaling, banking, and insurance than in retailing. It is evident that some leeway is permitted these services in locatin

[9] The Census of Population provides no breakdowns for wholesale and retail trade, but the Census of Distribution of 1935 gives statistics on these activities. While the totals covered by the two censuses are not the same, this does not invalidate the use of the latter to show distribution of wholesaling and retailing among States.

[10] One factor in the relatively low proportions of retail employees in agricultural States is that agriculturists do not need to buy for cash as much foodstuff as the townspeople buy from retailers.

their storage and administrative activities away from centers of industry generally. This policy has already been adopted to some extent by insurance companies maintaining their main offices in Iowa or Connecticut, rather than the financial center of New York City.

Professional Service

Professional service engaged about 3,318,000 persons or 8 percent of the total employed workers in 1940, including 395,000 persons in recreation and amusement. The highest proportions of professionals among all gainfully occupied were in California with 11.0 percent, and New York and Colorado with 10.4 percent each. The 10 States with the lowest proportions were all in the South, Mississippi lowest of all with 4.6 percent. That there is a "floor" at all in the low-income areas is due mainly to the presence of school teachers. Professional service is the most evenly distributed of any of the groups of economic activity considered here.[11]

Personal Service

For the whole United States, the percentage in personal service among all employed persons in 1940 was roughly 9 percent, including 2,327,000 persons in domestic service. The highest proportion among all employed persons occurred in Florida with 17.1 percent, Georgia with 12.9 percent, Louisiana with 12.2 percent, and Texas with 11.1 percent.

One factor common to these States with unusually high ratios of personal service is the tourist industry attracting great numbers of persons with concomitant demands for service. The chief clue to a relatively high proportion of personal service in an area probably lies, however, in the stimulus from low incomes and social traditions, forcing people to seek work as domestics, particularly in the case of the Negroes in the South.

Government Service

Approximately 1,753,000 or 3.9 percent of all employed persons in 1940 were in Government service. In addition to the District of Columbia and its neighboring States, there were, in 1940, unusual concentrations in a number of States due largely to the presence of military centers. The highest percentages were 8.8 in Wyoming, 7.1 in Virginia, 6.7 in Maryland and 5.9 in Washington. Some Government services, such as most Federal Government agencies, are clearly not "residentiary" in the sense that their functions are required specifically by the local population; others, such

[11] See table 1, coeffiients of localization.

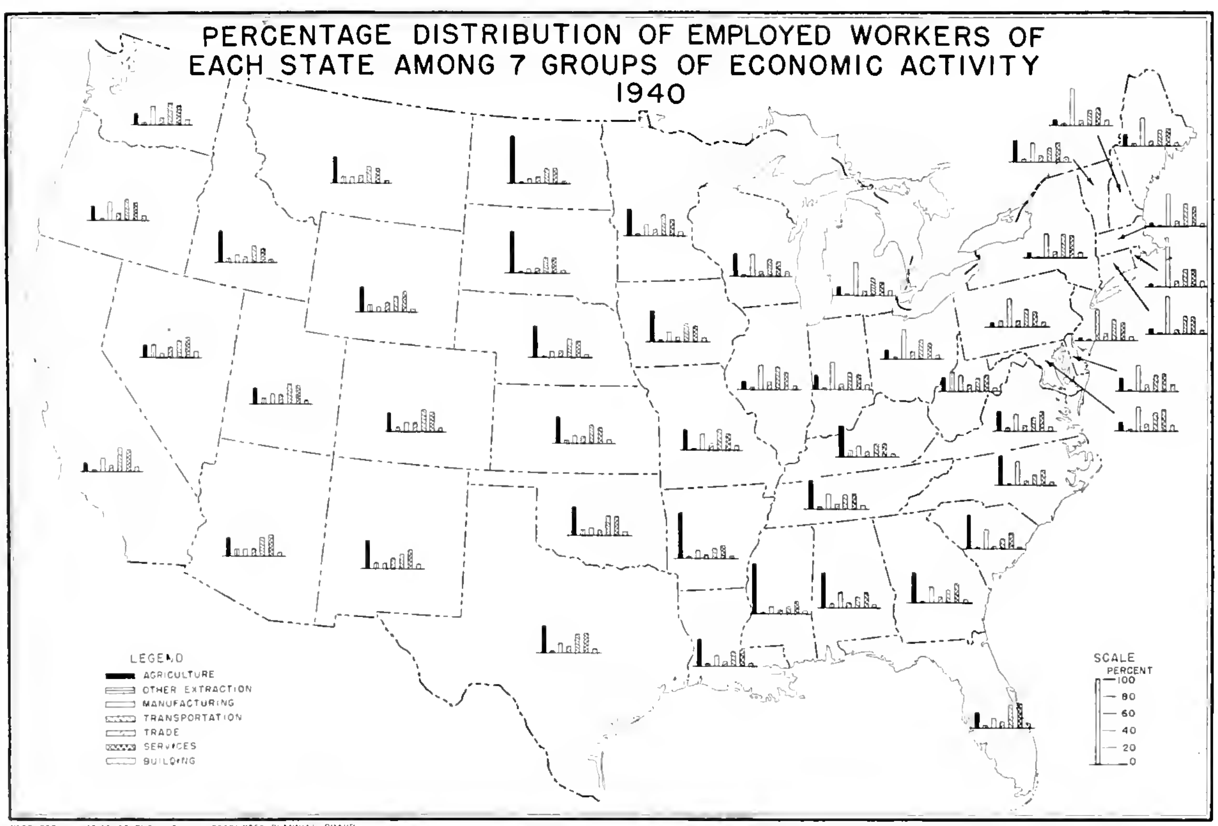


FIGURE 54

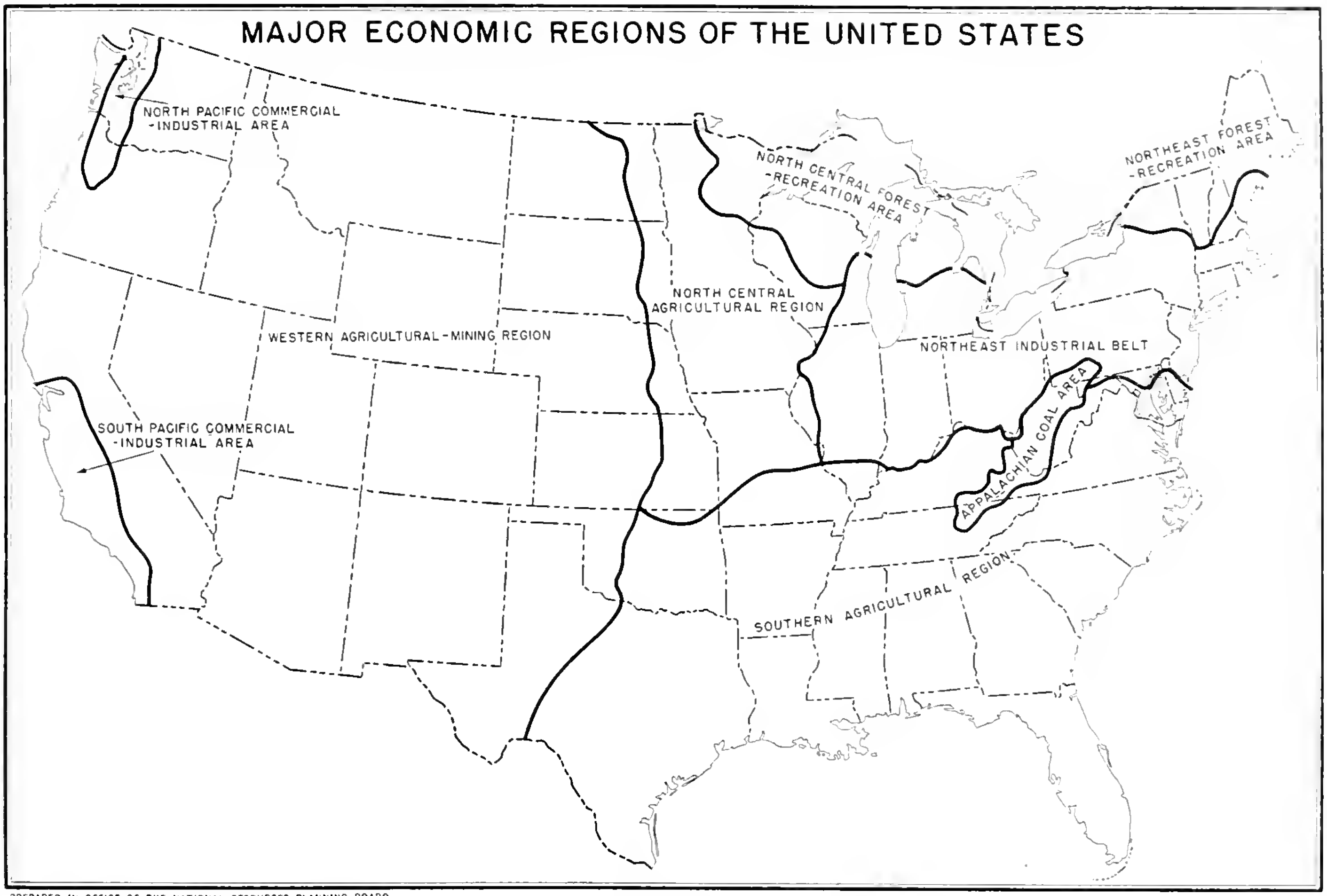


FIGURE 55

as police or local governments, clearly are residentiary. Relative to professional and personal service, public service is concentrated geographically.

Regional Patterns of Economic Activity

The composition of the labor force of each State is summarized in figure 54, which shows the relative importance of each of seven major groups of economic activity by proportionate vertical bars. States are seen to group themselves for the most part in contiguous area or regions with the same principal economic activity, whether agriculture, manufacturing, or mining. The distribution of employed workers among the various activities appears far more even in the Pacific and most of the Mountain States than in the States east of the Rocky Mountains. The tendency for greater development of the services where there is intense manufacturing activity also appears strikingly in this map.

In figure 55, the area of the United States is divided roughly into regions or areas having for the most part the same economic characteristics. Any attempt to define a few homogeneous areas in a country as vast and diversified as the United States must perforce adopt arbitrary criteria. Here we have considered two factors discussed in this chapter, population density and principal economic activity, and in addition the level of income. This regional break-down serves not only as a rough summary of the material presented in this chapter but also as a general frame of reference for later sections on analysis of regional industrial development.

Nine general regions are identified: the Northeast and North Central Forest-Recreation Areas, the Northeast Industrial Belt, the Appalachian Coal Region, the Southern Agricultural Region, the North Central Agricultural Region, the Western Agricultural-Mining Region, and the North and South Pacific Industrial-Commercial Areas. The boundaries are established on the basis of these criteria: principal economic activity (manufacturing, manufacturing and trade combined, agriculture, or mining) measured in percentage of gainful workers; density of population per square mile; and relative income level, as indicated by plane

of living indexes.[12] In addition, boundaries between agricultural areas are based in part on consideration of leading types of farming. County statistics have been used but the boundaries have been generalized and do not necessarily follow county lines. While the regions defined include wide ranges in population density, income level, and distribution of gainful workers among various economic activities, they mark off the most important geographic variations in these factors.

The Northeast and North Central Forest-Recreation Areas [13] are characterized by an average population density of approximately 25 persons per square mile and for the most part by a medium plane of living index. The principal economic activity is farming, with greater proportions of gainful workers in forestry and fishing than in the country as a whole or in contiguous regions. In addition, the North Central Area has relatively greater activity in mining.

The Northeast Industrial Belt is a predominantly manufacturing area, marked by a relatively high plane of living and an average population density of roughly 50 persons per square mile. In many counties the density exceeds several hundred persons per square mile.

The Appalachian Coal Area has been delineated on the basis of proportion of gainful workers in mining greater than those in any other activity. Several of the counties grouped in this area have high proportions in manufacturing as well. In the North, the industrial pattern is closely tied to and merges with the manufacturing and mining activities of the Pittsburgh area as a whole. It should be noted in this instance particularly that the boundaries established are not intended to suggest separate and unrelated economic functions but principal local activity. The population density of the Appalachian Coal Area as a whole is high, averaging about 25 persons per square mile and, in the northernmost counties, about 100 persons per square mile. The plane of living index is relatively low with the exception of the counties near Pittsburgh where it is medium.

The Southern Agricultural Region, with cotton the dominant crop, has an average population density of roughly 50 persons per square mile. The plane of living index is low with the exception of Florida where it is medium. The Florida area differs from the rest of the region in other respects as well and should perhaps be classified separately as a recreation area. The North Central Agricultural Region, which is largely a corn-growing area except for wheat in the northern part, has an average population density of roughly 30 persons per square mile, a medium plane of living in the north and a high plane of living in the middle and southern parts.

A vast area in the west has been classified in the Western Agricultural-Mining Region where the chief activities are mining and stock raising. The high proportions of gainful workers in transportation reflect the geographic position of these States, which serve as an avenue of communication between the more densely populated areas to the east and west. Many irrigated sections, which have entirely different population and agricultural patterns, are included in this region. Since these sections are small and scattered, they cannot be grouped in a separate economic unit. The region as a whole has a low population density, rarely higher than 25 persons per square mile and averaging about 5 persons per square mile. The plane of living index is medium.

Two areas on the West coast have been differentiated as Pacific Commercial-Industrial. For the territory so designated the population density is markedly higher than the surrounding area, averaging roughly 35 persons per square mile, with very high densities in the urban areas. While these areas include a high proportion of agricultural workers, the combination of manufacturing and trade activities is preponderant and the plane of living index relatively high.

Conclusion

The broad regional distribution of economic activities sketched in this chapter serves as a foundation for the comprehensive analysis of specific locational factors treated in the subsequent portions of this volume. Together with the geographic distribution of natural resources, the elements here treated, whether evolved by underlying economic forces or historical accident, constitute the basic data which national locational policy must employ as its starting point.

[12] See Carter Goodrich *et al.*, *Migration and Economic Opportunity*, Philadelphia, 1936, map opp. p. 14.

[13] For more detailed discussion of the economy of this type of region, see National Resources Committee, *Regional Planning, Part VIII–Northern Lakes States*, 1939

CHAPTER 4. SHIFTS OF MANUFACTURING INDUSTRIES

By Daniel Creamer [1]

The problems of industrial location, it has been pointed out, arise chiefly in connection with manufacturing. The location of extractive and service industries can be simply explained; the factors determining the location of manufactures are, generally speaking, numerous, and their interactions are complex and dynamic. Marked changes in the locational pattern may occur in many industries over a short period.

This chapter attempts to measure, describe, and explain the geographic changes which have occurred in American manufacture, as reflected by the redistribution of manufacturing employment between 1929 and 1937.[2] By 1937 there had been substantial recovery from the great depression of the earlier years of the decade, and manufacturing activity was again at a high level. Moreover, readjustments to wartime needs had not yet commenced. A comparison of the locational pattern of 1937 with that of 1929 should thus indicate the broad developments during recent years, free of serious distortion from cyclical or abnormal influences. Conclusions are, of course, restricted by the limitations of analysis of a single time period.

The following discussion is devoted primarily to a measurement, industry by industry, of the divergence of the trend of employment in individual States from that of the Nation as a whole. These divergences will be termed "locational shifts," or simply, "shifts." A locational shift means the difference between the change in the number and distribution of wage jobs which actually occurred in a given industry in a given State and that change which would have resulted if this industry had grown or declined in the State at the same rate it did in the Nation.[3]

[1] Economist, Bureau of Labor Statistics. Assisted by Richard H. Lewis and Jesse L. Sternberger of the Bureau of Labor Statistics. Prepared under the direction of Emmett H. Welch, Chief of the Division of Occupational Outlook, Bureau of Labor Statistics.

[2] Changes in output per wage earner or per man-hour probably would provide a helpful basis of classification but the requisite data are inadequate for a comprehensive and systematic presentation. Changes in output can be used to supplement changes in employment, especially for industries with declining employment. With such information it is possible to distinguish the predominant cause of the decreasing volume of employment, whether it is due to decline in the consumer demand for the product or to extreme technological displacement of labor. The latter condition must be said to prevail when sharp increases in production accompany appreciable decreases in numbers employed.

[3] It makes no difference in our measurement whether the shift involved (1) the dismantling of a plant in one locality and the shipment of its equipment to another; (2) the development of a new establishment by an existing concern, with or without dismantlement of an old establishment; (3) the development of a new establishment by a new concern; (4) the expansion of productive capacity of a going establishment; or (5) merely differences in the degree of utilization of existing capacity.

Industries Grouped According to Changes in Employment

As a preliminary, it is necessary to see to what extent employment opportunities changed between 1929 and 1937 in individual industries in the country at large. In order to keep the investigation within manageable proportions, the analysis has been confined to those industries, of the 350 covered by the 1937 *Census of Manufactures*, which reported an average of more than 10,000 wage earners either in 1929 or 1937. The 141 such industries or industry groups employed, both in 1929 and 1937, more than 90 percent of all wage earners in manufactures nationally;[4] they are regarded in this chapter as the "total," whether the reference is to the State or the Nation.

The percentage change from 1929 to 1937 in the average number of wage earners was computed for each of the 141 industries which were then grouped according to the following changes in wage earners employed:

Group I. Increases of 24.0 percent or more;

Group II. Increases from 6.0 to 23.9 percent;

Group III. Increases from 1 to 5.9 percent, i. e., from virtually no change to increases up to that in total population;

Group IV. Increases or decreases less than 1 percent, i. e., virtually no change in employment;

Group V. Decreases from 1.0 to 10.9 percent;

Group VI. Decreases from 11.0 to 20.9 percent;

Group VII. Decreases of 21.0 or more.

This seven-group arrangement is shown in table 1, industries being listed in each group in order of the number of wage earners employed in 1929.

The industries in group I, as would be expected, were typically smaller than those in group II, which in turn averaged smaller than those in group III. The respective medians in terms of wage earners in 1929, were 16,000; 24,000; and 31,000. Among the declining industries, there was no uniform relationship between size and percentage decline. The group with the largest relative decline (VII) was heavily weighted with manufactures used mainly in the building industry, which had made only a comparatively small recovery by 1937.

[4] In some cases, combination of industries was necessary to achieve comparability of classifications in 1929 and 1937.

TABLE 1.—*Selected industries classified by increase or decrease, 1929–1937, in average number of wage earners*

Industry	Average number of wage earners		Percent increase or decrease 1937 over 1939	Per-cent of group total 1929	Cumulative per-cent of group total 1929
	1929	1937			
Grand total	7,795,163	8,039,143			
Group I: Increase, 24.0 percent or more.					
Motor vehicle bodies, parts	221,332	284,814	28.7	22.2	22.2
Women's clothing	187,500	242,879	29.5	18.8	41.0
Canning, fruits, vegetables, etc	98,866	137,064	38.6	9.9	50.9
Chemicals [1]	63,683	78,951	24.0	6.4	57.3
Agricultural implements	61,140	77,512	28.6	6.1	63.4
Stamped ware, enameled ware, etc	40,000	61,092	[2] 52.7	4.0	67.0
Rayon and allied products	39,106	55,098	40.9	3.9	71.3
Refrigerators	26,667	50,623	[3] 89.8	2.7	74.0
Wirework [2]	22,388	33,471	49.5	2.2	76.2
Paper goods [1]	20,227	32,888	[3] 62.6	2.0	78.2
Lithographing	18,979	24,079	26.9	1.9	80.1
Typewriters and parts	16,945	21,440	[2] 26.5	1.7	81.8
Cash registers, adding machines, etc	16,840	23,630	[3] 40.3	1.7	83.5
House furnishings [2], and fabricated textiles	16,631	23,894	43.7	1.7	85.2
Leather goods, [1] handbags, etc	16,465	20,852	26.6	1.6	86.8
Aircraft and parts	14,710	24,003	63.2	1.5	88.3
Canning, fish, etc	13,612	18,229	33.9	1.4	89.7
Photographic apparatus, etc	12,967	18,450	42.3	1.3	91.0
Food preparations [1]	10,616	16,794	58.2	1.1	92.1
Feeds, prepared for animals and fowls	10,223	14,397	40.8	1.0	93.1
Gloves and mittens, cloth, etc	9,279	12,679	36.6	.9	94.0
Gloves and mittens, leather	9,203	11,637	26.4	.9	94.9
Buttons	9,034	12,026	33.1	.9	95.8
Knit cloth	8,491	11,360	33.8	.8	96.6
Asbestos products	8,092	13,023	60.9	.8	97.4
Wallboard, gypsum products	7,462	11,590	[2] 55.3	.7	98.1
Bags, paper	6,970	10,360	48.6	.7	98.8
Sausage, meat pudding, etc	5,897	10,217	73.3	.6	99.4
Pulp goods and synthetic resin	5,654	16,673	194.9	.6	100.0
Liquors, other than malt	186	16,314			
Liquors, malt		47,037			
Group total	999,165	1,433,076		100.0	
Group II, Increase, 6 percent or more:					
Steel works and rolling mills	394,574	479,342	21.5	23.3	23.8
Men's clothing—total	278,633	317,517	14.0	16.5	39.0
Bread, other bakery products	200,841	239,388	19.2	11.9	51.7
Hosiery	129,542	150,460	[3] 16.1	7.7	59.4
Paper	103,320	110,809	7.2	6.1	65.5
Glass	67,527	79,051	17.1	4.0	69.5
Woolen goods	58,474	67,264	[4] 15.0	3.5	73.0
Boxes paper [1]	55,654	65,158	17.1	3.3	76.3
Ship and boat building	55,089	62,274	13.0	3.3	79.6
Rubber goods, other	40,226	48,172	19.8	2.4	82.0
Paints	29,211	31,664	8.4	1.7	83.7
Machine tool accessories	26,682	32,893	23.3	1.6	85.3
Pulp, wood and other fibre	24,729	26,994	9.2	1.5	86.8
Pumps and pumping equipment	23,106	28,320	[3] 22.6	1.4	88.2
Wire drawn from purchased rods	22,467	24,580	9.4	1.3	89.5
Clocks, watches, etc	21,450	23,223	8.3	1.3	90.8
Aluminum	21,210	23,695	11.7	1.3	92.1
Cigarettes	21,142	26,149	23.7	1.3	93.4
Screw machine products and wood screws	19,881	21,287	7.1	1.2	94.6
Wood turned and shaped	18,712	23,087	[3] 23.4	1.1	95.7
Mattresses, bedsprings [1]	17,187	19,165	11.5	1.0	96.7
Cutlery and edge tools	14,991	16,830	12.3	.9	97.6
Corsets and allied garments	13,664	16,385	19.9	.8	98.4
Wrought pipe, etc	11,417	14,125	23.7	.7	99.1
Mirrors and other glass products	10,811	12,652	17.0	.6	99.7
Optical goods	9,701	11,998	23.7	.6	100.3
Group total	1,690,241	1,972,482		100.3	
Group III, Increase, 1.0–5.9 percent					
Boots, shoes (nonrubber)	205,640	215,438	4.8	17.9	17.9
Printing and publishing, newspapers and periodicals	129,660	135,215	4.3	11.3	29.2
Meat packing, wholesale	122,505	127,477	4.1	10.6	39.8
Worsted goods	88,935	90,782	2.1	7.7	47.5
Heating and cooking apparatus	86,237	89,287	3.5	7.5	55.0
Petroleum refining	80,596	83,182	3.2	7.0	62.0
Non-ferrous alloys and products [1]	79,183	83,016	4.8	6.9	68.9
Hardware [1]	52,306	53,000	1.3	4.5	73.4
Leather	49,932	50,687	1.5	4.3	77.7
Cars, electric, steam railroad	40,015	40,466	1.1	3.5	81.2

TABLE 1.—*Selected industries classified by increase or decrease, 1929–1937, in average number of wage earners*—Continued

Industry	Average number of wage earners		Percent increas or decrease 1937 over 1929	Per-cent of group total 1929	Cumulative per-cent of group total 1929
	1929	1937			
Group III—Continued					
Tin cans and other tinware [1]	31,497	33,145	[3] 5.2	2.7	83.9
Knit outerwear	28,968	29,321	1.2	2.5	86.4
Drugs, etc	27,122	28,417	4.8	2.4	88.8
Bookbinding and blank book making	24,754	25,333	2.3	2.2	91.0
Butter	19,097	19,437	1.8	1.7	92.7
Toys, games and playground equipment	16,660	17,547	5.3	1.4	94.1
Bolts, nuts, washers, etc	16,175	16,840	4.1	1.4	95.5
Cottonseed products	15,825	16,583	4.8	1.4	96.9
Caskets, coffin, etc	13,033	13,678	4.9	1.1	98.0
Bags, other than paper	11,828	12,075	2.1	1.0	99.0
Sporting and athletic goods	10,793	11,392	5.5	.9	99.9
Group total	1,150,761	1,192,318		99.9	
Group IV, Increase, .9 percent or less, to decrease, 1.0 percent or less:					
Cotton goods	424,916	422,310	[4] −.5	76.6	76.6
Machine tools	47,391	47,266	−.3	8.5	85.1
Fertilizers	20,926	20,893	−.2	3.8	88.9
Coke	20,552	20,603	.2	3.7	92.6
Smelting and refining, copper	14,544	14,514	−.2	2.6	95.2
Sugar refining, cane	13,912	14,024	.8	2.5	97.7
Photoengraving	12,353	12,364	.1	2.2	99.9
Group total	554,594	551,974		99.9	
Group V, Decrease, 1.1-10.9 percent:					
Foundry and machine shop products	456,736	432,982	[5] −5.2	28.6	28.6
Electrical machinery, radios	343,138	308,551	−10.1	21.5	50.1
Printing and publishing, job or book	155,933	141,368	−9.3	9.8	59.9
Silk and rayon goods	130,467	116,839	[5] −10.4	8.2	68.1
Dyeing and finishing	79,327	77,545	[4] −2.2	5.0	73.1
Knit underwear	41,487	39,923	−3.8	2.6	75.7
Pottery	35,409	33,060	−6.6	2.2	77.9
Carpets and rugs, wool	32,623	30,779	−5.7	2.0	79.9
Beverages, nonalcoholic	28,281	27,979	−1.1	1.8	81.7
Plumbers supplies	27,960	25,240	−9.7	1.8	83.5
Flour	27,028	26,390	−2.4	1.7	85.2
Textile machinery aud parts	27,019	25,340	−6.2	1.7	86.9
Blast furnaces	24,960	23,075	−7.6	1.6	88.5
Lighting equipment	23,580	21,743	−7.8	1.5	90.0
Boot and shoe cut stock and findings	19,875	18,755	−5.6	1.2	91.2
Cast iron pipe	19,741	17,613	−10.8	1.2	92.4
Tools, not including edge tools, machine tools	19,305	17,612	−8.8	1.2	93.6
Hats, fur felt	16,539	15,926	−3.7	1.0	94.6
Cordage and twine	14,489	14,043	−3.1	.9	95.5
Soap	14,363	14,008	−2.5	.9	96.4
Wood preserving	13,077	12,401	−5.2	.8	97.2
Smelting and refining, zinc	11,618	11,265	−3.0	.7	97.9
Tobacco and snuff	10,811	10,130	−6.3	.7	98.6
Cooperage	10,691	9,588	−10.3	.7	99.3
Envelopes	10,367	9,511	−8.3	.7	100.0
Group total	1,594,824	1,481,666		100.0	
Group VI, Decrease, 11.0-20.9 percent:					
Motor vehicles	226,116	194,527	−14.0	31.4	31.4
Furniture	193,399	170,072	−12.1	26.9	58.3
Confectionery	63,501	53,722	−15.4	8.8	67.1
Cement	33,368	26,426	−20.8	4.6	71.7
Boxes, wooden, except cigar	30,554	25,981	−15.0	4.2	75.9
Sheetmetal work	28,593	22,973	−19.7	4.0	79.9
Jewelry	27,922	22,838	−18.2	3.9	83.8
Ice cream	22,399	18,664	−16.7	3.1	86.9
Forgings	20,882	18,255	−12.6	2.9	89.8
Signs and advertising novelties	20,000	16,042	−19.8	2.8	92.6
Fur goods	15,752	12,952	[6] −19.8	2.2	94.8
Cotton small wares	15,281	12,616	−17.4	2.1	96.9
Locomotives	11,045	9,000	−18.5	1.5	98.4
Sewing machines, attachments	10,467	9,019	−13.8	1.5	99.9
Group total	719,279	613,087		99.9	
Group VII, Decrease, 21.0 percent or more:					
Lumber	419,084	323,928	−22.7	38.6	38.6
Clay products	93,657	65,226	−30.4	8.6	47.2
Planing mill products	90,134	66,814	−25.9	8.3	55.5
Cigars	84,166	55,879	−33.6	7.7	63.2
Rubber tires and inner tubes	83,263	63,290	−24.0	7.7	70.9
Structural and ornamental metalwork	54,947	38,814	−29.4	5.1	76.0

TABLE 1.—*Selected industries classified by increase or decrease, 1929–1937, in average number of wage earners*—Continued

Industry	Average number of wage earners		Percent increase or decrease 1937 over 1929	Percent of group total 1929	Cumulative percent of group total 1929
	1929	1937			
Group VII—Continued.					
Engines, turbines, etc	43,225	32,855	−24.0	4.0	80.0
Marble, granite, slate, etc	37,817	20,816	−45.0	3.5	83.5
Millinery	32,206	21,560	[4]−33.1	3.0	86.5
Ice, manufactured	32,184	18,705	−41.9	3.0	89.5
Boots and shoes, rubber	25,659	18,356	−28.5	2.4	91.9
Instruments and apparatus, professional, etc	22,977	17,399	[5]−24.3	2.1	94.0
Concrete products	16,505	12,840	−22.2	1.5	95.5
Silverware and plated ware	15,735	11,361	−27.8	1.4	96.9
Perfumes, cosmetics, etc	13,109	10,158	[5]−22.5	1.2	98.1
Trunks, suitcases, bags, etc	11,359	8,708	−23.3	1.0	99.1
Engraving, steel and copper plate and wood	10,272	7,831	−23.8	.9	100.0
Group total	1,086,299	794,540		100.0	

[1] Not elsewhere classified.
[2] Percentage increase is understated because of a contraction from 1929 to 1937 in the Census of Manufactures' definition of the industry.
[3] Percentage increase is overstated because of an expansion from 1929 to 1937 in the Census of Manufactures' definition of the industry.
[4] A change was made from 1929 to 1937 in the Census of Manufactures' definition of the industry, but the net effect of the change is not definitely known. Any upward or downward bias is probably slight and 1929 and 1937 figures are believed to be generally comparable.
[5] Percentage decrease is overstated because of a contraction from 1929 to 1937 in the Census of Manufactures' definition of the industry.
[6] Percentage decrease is overstated because 1937 is not strictly comparable with 1929 as a result of incomplete coverage of the industry by the 1937 Census.

SOURCE: *Census of Manufactures*, 1929 to 1937.

The importance of each of the seven groups is shown in table 2. Industries in group I, in which employment increased between 1929 and 1937 by 24 percent or more, made up about one-eighth of the total of the 141 industries in 1929. More than one-fifth of the wage jobs were in the industries of group II, and over one-seventh in group III. Thus, nearly half of the wage earners (49.3 percent) were in industries that expanded from 1929 to 1937, and more than one-third were in industries that expanded faster than the growth of population.

TABLE 2.—*Absolute and relative number of wage jobs in 7 industry groups based on percent change in number of wage jobs, 1937 over 1929*

Industry groups	Number of wage jobs		Percent of United States total	
	1929	1937	1929	1937
Group I, increase in wage jobs of more than 24.0 percent from 1929 to 1937	999,165	1,433,076	12.8	17.8
Group II, increase in wage jobs of 6.1 percent to 24.0 percent from 1929 to 1937	1,690,241	1,972,482	21.7	24.5
Group III, increase in wage jobs of 1.1 percent to 6.0 percent from 1929 to 1937	1,150,761	1,192,318	14.8	14.8
Group IV, increase or decrease in wage jobs not exceeding 1 percent from 1929 to 1937	554,594	551,974	7.1	6.9
Group V, decrease in wage jobs of 1.0 percent to 10.9 percent from 1929 to 1937	1,594,824	1,481,666	20.5	18.5
Group VI, decrease in wage jobs of 11.0 percent to 20.9 percent from 1929 to 1937	719,279	613,087	9.2	7.6
Group VII, decrease in wage jobs of more than 21.0 percent from 1929 to 1937	1,086,299	794,540	13.9	9.9
United States total	7,795,163	8,039,143	100.0	100.0

Industries that were to attain the same employment level in 1937 as in 1929 (group IV) accounted for 7 percent of the wage jobs, while as many as one-fifth were in industries that were to sustain a reduction of 1 to 11 percent (group V). About half as many wage jobs as in group V were in industries in which employment was to decline by 11 to 21 percent (group VI). Finally, industries with the largest relative decreases (group VII), included about one-seventh of all wage jobs. That is, between 43 and 44 percent of the total wage jobs were in declining industries, measured in terms of 1929 employment opportunities.[5]

Types of Shifts

Locational shift has been said to occur when the change in employment in a given industry in a particular State differs in degree from the change in the same industry on a national basis. Obviously, locational shifts so measured might be into a State or away from it. Shifts in either direction, moreover, may be further classified. Thus, an industry shift into a State may result either from employment in the given State increasing at a greater rate than it has in the Nation at large, or from employment increasing in the State while it has declined nationally. These changes may be considered as "absolute shifts" into the State; they are measured in the former instance by the difference between the actual growth and the State's proportionate share of the national increase, and in the latter case by the sum of the actual increase and the State's share of the national decline. These absolute shifts are in contradistinction to "relative shifts" into a State, which may be said to occur when an industry that has contracted nationally declines at a lesser rate in the given State. Despite the actual decrease in wage jobs, one may speak of a relative gain (hence, a shift into the State) that is measured by the difference between the actual number of wage jobs at the end of the period and the number that would have obtained had

[5] However, for 26 of the latter industries, representing 40.2 percent of the wage jobs in groups V, VI, and VII, indexes of physical production are available and these reveal that 8 of the industries, accounting for 24 percent of the wage earners in declining industries, either increased production or retained the same level. For these 8 industries the decline was limited solely to employment, suggesting that technological changes were the predominant cause for the smaller volume of employment opportunities rather than a falling demand. These eight industries are: Beverages, nonalcoholic; hats, fur felt; knit goods, underwear; silk and rayon; soaps; ice cream; confectionery; and sewing machines and attachments.

The other 18 declining industries in which there was also a decline in production are: Blast furnaces; carpets and rugs; wool; cast-iron pipe; tobacco (chewing and smoking) and snuff; boots and shoes; rubber; cigars; clay products; concrete products; ice, manufactured; lumber-mill products, n. e. c.; planning-mill production, n. e. c.; rubber tires and inner tubes. Data on changes in physical production of manufactures have been adapted from Solomon Fabricant, *The Output of the Manufacturing Industries, 1899–1937*, New York, National Bureau of Economic Research, 1940, p. 685 ff.

the State sustained its proportionate share of the decline.

Shifts away from a State can be similarly classified. They occur in absolute terms when an industry that has been expanding nationally contracts its employment in the given State, or when an industry that has been declining nationally falls at a greater rate in the given State. The extent of the former type of shift is the sum of the actual decline and the hypothetical gain had the given State received its proportionate share of the expansion, whereas the latter type of outward shift is measured by the difference between the actual decline and that which would have taken place had the given State lost proportionately with the Nation. The relative outward shift occurs when an industry that has expanded nationally has grown at a lesser rate in the given State. Although there was an increase in the number of wage jobs, with respect to the particular industry, the given State was losing ground in relative terms to other States. This is measured by the difference between the actual gain and the hypothetical gain had there been a proportionate distribution of the national increase in the State concerned.

It follows from these definitions that in a given industry on a national basis all the wage jobs in inward shifts (absolute and/or relative) equal the number of wage jobs in outward shifts (absolute and/or relative). Thus, for a given industry the total number of wage jobs involved in shifts is the total of wage jobs in all shifts divided by two.

With these statistical measures it is proposed to determine the differentials in locational shifts among specific industries.

General Characteristics of Shifting and Nonshifting Industries

The degree of change in each industry has been measured by totaling all shifts that exceeded 250 wage jobs in any State, dividing by two, and expressing this quotient as the ratio to the number of wage jobs in that industry in 1937. These shift-ratios are presented for 139 industries in table 3.[6] For the entire group, the median shift-ratio was 8.6 percent, and for nearly two-thirds of the 139 industries the ratio was less than 11 percent. Of more significance is the fact that the median ratio for the expanding industries was one-third larger than that for the contracting industries, 10.5 and 7.8, respectively. This is not an unexpected result: an industry in which new capacity is being constructed can be shifted more easily than one burdened with considerable unused capacity.

[6] Ratios could not be computed for liquors, malt, and liquors other than malt, since these industries were virtually nonexistent in 1929.

It will be noted further that for the groups of expanding industries there was a direct relationship between the degree of expansion and the size of the median shift-ratio. The smaller the industry in terms of wage jobs the larger the shift-ratio and the percentage expansion which a given number of wage-jobs shifts represents; and as previously indicated, the average size of the industries in groups I, II, and III, was in ascending order.[7] Since among the declining industries there was no similar correspondence between size and percentage decrease there was no direct relation of percentage decline and median shift-ratio.

[7] In other words, among the three groups of expanding industries, the group with the highest expansion contained on the average the smallest industries, and the media shift-ratio was therefore the largest.

TABLE 3.—*Classification of 139 selected industries*[1] *by percent change from 1929 to 1937 in number of wage earners, by extent of locational shifts 1929 to 1937, by coefficient of scatter 1929, and by wages as a percent of value added by manufacture, 1937*

Industry	Number of wage earners in 1937	Number of wage earners in locational shifts 1929–37[2]	Wage earners in locational shifts as a percent of 1937 total (shift ratio)	Coefficient of scatter[3]	Wages as a percent of value added by manufactures, 1937
Group I (Increase of 24.0 percent or more)					
Shifting industries[4]:					
Aircraft and parts	24,003	11,930	49.7	8	49.3
Cash registers, adding machines	23,630	5,368	22.7	3	32.0
Rayon and allied products	55,098	11,432	20.7	4	37.5
Leather goods, and handbags[5]	20,852	4,080	19.6	4	44.6
Paper goods[5]	32,888	6,235	19.0	6	30.7
Wallboard, gypsum products	11,590	2,079	17.9	9	25.9
Plastics (synthetic resins etc.)[6]	16,673	2,809	16.8	6	43.3
Bags, paper	10,360	1,673	16.1	6	33.8
Gloves and mittens, cloth	12,679	2,038	16.1	5	56.1
Motor vehicle bodies and parts	284,814	45,689	16.0	4	54.7
Buttons	12,026	1,864	15.5	4	52.1
Refrigerators	50,623	7,810	15.4	5	42.3
Stamped and enameled ware	61,092	8,863	14.5	8	50.1
Canning, fish, etc	18,229	2,584	14.2	5	29.3
Housefurnishings and fabricated textiles	23,894	3,277	13.7	6	37.7
Women's clothing	242,879	27,142	11.2	5	46.2
Wirework[5]	33,471	3,586	10.7	7	45.5
Agricultural implements	77,512	8,296	10.7	4	43.8
Chemicals[5]	78,951	6,126	7.8	8	24.5
Canning, fruits and vegetables	137,064	10,512	7.7	10	31.9
Nonshifting industries[7]:					
Knit cloth	11,360	1,234	10.9	4	44.7
Typewriters and parts	21,440	2,220	10.4	2	82.3
Feeds, prepared for animals, etc.	14,397	1,345	9.3	14	20.6
Lithographing	24,079	1,935	8.0	6	43.0
Food preparations[5]	16,794	748	4.5	10	19.8
Gloves and mittens, leather	11,637	258	2.2	2	60.0
Sausage, meat puddings, etc	10,217	154	1.5	9	38.1
Photographic apparatus	18,450	139	.8	1	36.5
Median shift ratio			14.2		

[1] Since the liquors, malt and liquors, other than malt industries were nonexistent in 1929, there would be no locational shifts between 1929 and 1937, and hence they have been excluded from this table.

[2] Excluding shifts in any State of less than 250 wage jobs.

[3] The coefficient of scatter is the number of States that accounted for at least 75 percent of the wage jobs in a given industry.

[4] Shifting industries are those with more than 2,500 wage jobs in locational shifts whose shift-ratios are above the first quartile, and those with less than 2,500 wage jobs in locational shifts but whose shift ratios are in the fourth quartile.

[5] Not elsewhere classified.

[6] 1931 figure.

[7] Nonshifting industries are those with less than 2,500 wage jobs in locational shifts whose shift ratios are below the fourth quartile, and industries with more than 2,500 wage jobs in locational shifts but whose shift ratios are in the first quartile. The foundry and machine shop production industry has been excepted from this rule and has been considered as a shifting industry because of the absolute size of the locational shift, even though its shift ratio falls in the first quartile.

Table 3.—*Classification of 139 selected industries by percent change from 1929 to 1937 in number of wage earners, by extent of locational shifts 1929 to 1937, by coefficient of scatter 1929, and by wages as a percent of value added by manufacture, 1937*—Continued

Table 3.—*Classification of 139 selected industries by percent change from 1929 to 1937 in number of wage earners, by extent of locational shifts 1929 to 1937, by coefficient of scatter 1929, and by wages as a percent of value added by manufacture, 1937*—Continued

Industry	Number of wage earners in 1937	Number of wage earners in locational shifts 1929-37	Wage earners in locational shifts as a percent of 1937 total (shift ratio)	Coefficient of scatter	Wages as a percent of value added by manufactures, 1937
Group II (Increase of 6.0 to 23.9 percent)					
Shifting industries:					
Wire drawn from purchased rods	24,580	5,137	20.9	5	41.6
Pulp, wood and other fibre	26,994	5,430	20.1	8	35.9
Wrought pipe	14,125	2,634	18.6	3	43.0
Mirrors and other glass products	12,652	2,029	16.0	6	29.6
Pumps and pumping equipment	28,320	4,465	15.8	8	35.0
Cutlery and edge tools	16,830	2,516	14.9	5	37.6
Ship and boat building	62,274	8,278	13.3	9	62.9
Woolen goods	67,264	8,078	12.0	8	52.7
Aluminum products	23,695	2,848	12.0	5	45.9
Hosiery	150,460	17,952	11.9	6	67.6
Cigarettes	26,149	3,067	11.7	2	12.3
Men's clothing, total	317,517	36,919	11.6	8	54.1
Rubber goods, other	48,172	5,092	10.6	6	44.1
Glass	79,051	6,324	8.0	5	41.1
Boxes, paper [5]	65,158	4,912	7.5	9	38.6
Steel works and rolling mills	479,342	33,398	7.0	5	52.1
Paper	110,809	7,180	6.5	9	36.4
Nonshifting industries:					
Wood turned and shaped	23,087	2,478	10.7	12	52.1
Corsets and allied garments	16,385	1,624	9.9	4	34.7
Optical goods	11,998	933	7.8	2	43.9
Mattresses and bedsprings	19,165	1,397	7.3	11	39.7
Clocks, watches, etc	23,223	1,682	7.2	3	46.4
Machine tool accessories	32,893	1,798	5.5	5	48.3
Screw machine products and wood screws.	21,287	1,138	5.3	5	46.7
Bread and other bakery products	239,388	7,847	3.3	13	42.1
Paints	31,664	810	2.6	7	18.9
Median shift ratio			10.65		
Group III (Increase of 1.0 to 5.9 percent)					
Shifting industries:					
Hardware [5]	53,000	8,087	15.3	5	49.4
Knit outerwear	29,321	3,936	13.4	5	46.7
Bookbinding and blank book making	25,333	3,188	12.6	5	44.8
Nonferrous alloys and products [5]	83,016	7,877	9.5	6	41.7
Cars, electric and steam railroad	40,466	3,762	9.3	7	54.5
Boots and shoes, other than rubber	215,438	18,492	8.6	6	54.3
Tin cans and other tinware	33,145	2,604	7.9	7	32.7
Heating and cooking apparatus	89,287	7,018	7.9	9	43.1
Meat packing, wholesale	127,477	9,450	7.4	11	42.5
Worsted goods	90,782	6,708	7.4	4	55.6
Nonshifting industries:					
Toys, games and playground equipment	17,547	2,006	11.4	7	42.9
Cottonseed products	16,583	1,398	8.4	7	18.3
Drugs, etc	28,417	2,376	8.4	9	10.8
Bolts, nuts, washers, etc	16,840	1,238	7.4	5	41.2
Petroleum refining	83,182	3,747	4.5	7	29.1
Leather	50,687	1,948	3.8	7	54.0
Printing and publishing, newspapers and periodicals	135,215	4,396	3.3	15	22.1
Sporting and athletic goods	11,392	280	2.5	7	51.8
Butter	19,437	322	1.7	12	24.6
Caskets, coffins, etc	13,678			11	39.6
Bags, other than paper	12,075			11	36.9
Medium shift ratio			7.9		
Group IV (Increase of 0.9 percent or less to decrease of 1.0 percent or less)					
Shifting industries:					
Cotton goods	422,310	54,904	13.0	5	57.2
Machine tools	47,266	4,300	9.1	7	43.0
Nonshifting industries:					
Sugar refining, cane	14,024	1,670	11.9	4	25.8
Smelting and refining, copper	14,514	1,008	6.9	5	29.8
Fertilizers	20,893	1,104	5.3	9	23.4
Photoengraving	12,364	605	4.9	7	46.4
Coke	20,603	694	3.4	7	39.2
Median shift ratio			6.9		
Group V (Decrease 1.0 to 10.9 percent)					
Shifting industries:					
Silk and rayon goods	116,839	30,511	26.1	4	59.1
Dyeing and finishing	77,545	16,490	21.3	5	51.0
Knit underwear	39,923	7,082	17.7	7	52.7
Carpets and rugs, wool	30,779	4,003	13.0	3	41.0
Beverages, nonalcoholic	27,979	2,915	10.4	17	18.9
Textile machinery and parts	25,340	2,542	10.0	3	46.0
Pottery	33,060	3,124	9.4	5	55.9
Electrical machinery and radios	308,551	23,964	7.8	6	37.0
Foundry machine-shop products	432,982	27,409	6.3	9	42.5
Nonshifting industries:					
Cooperage	9,588	1,003	10.5	12	52.0
Tools, not including edge or machine tools	17,612	1,809	10.3	7	43.0
Smelting and refining, zinc	11,265	1,067	9.5	4	41.8
Cordage and twine	14,043	1,150	8.2	9	41.2
Plumber's supplies	25,240	2,054	8.1	8	48.0
Hats, fur-felt	15,926	1,212	7.6	3	36.6
Lighting equipment	21,743	1,694	7.8	6	41.8
Soap	14,008	940	6.7	6	16.5
Boot and shoe, cut stock and findings	18,755	1,244	6.6	5	48.5
Flour	26,390	1,224	4.6	15	22.6
Envelopes	9,511	468	4.9	6	40.1
Cast iron pipe	17,613	814	4.6	4	50.7
Printing and publishing, book and job	141,368	5,151	3.6	9	37.1
Tobacco and snuff	10,130	353	3.5	6	18.8
Blast furnaces	23,075	564	2.4	4	29.8
Wood preserving	12,401	268	2.2	15	35.3
Median shift ratio			7.8		
Group VI (Decreases of 11.0 to 20.9 percent)					
Shifting industries:					
Motor vehicles	194,527	33,502	17.2	5	45.0
Boxes, wooden, except cigar	25,981	4,250	16.4	18	47.7
Furniture	170,072	12,455	7.3	9	49.3
Confectionery	53,722	3,928	7.3	9	35.3
Nonshifting industries:					
Forgings	18,255	2,012	11.0	6	46.5
Locomotives	9,000	705	7.8	2	45.0
Sheet metalwork	22,973	1,786	7.8	11	40.0
Signs and advertising novelties	16,042	1,246	7.8	9	40.0
Cotton small wares	12,616	840	6.7	4	51.9
Sewing machines, attachments	9,019	572	6.3	3	52.7
Ice cream	18,664	944	5.1	15	15.4
Cement	26,426	1,322	5.0	0	30.1
Fur goods	12,952	446	3.4	2	43.8
Jewelry	22,838	296	1.3	3	43.8
Median shift ratio			7.3		
Group VII (Decrease of 21.0 percent or more)					
Shifting industries:					
Boots and shoes, rubber	18,356	5,516	30.1	4	55.1
Instruments and apparatus	17,399	4,632	26.6	5	35.4
Engines, turbines, etc	32,855	7,928	24.1	6	47.0
Cigars	55,879	7,117	12.7	6	45.8
Rubber tires and inner tubes	63,290	7,913	12.5	3	46.3
Structural and ornamental work	38,814	4,042	10.4	10	43.8
Planing mill products	66,814	6,905	10.3	18	49.1
Lumber	323,928	22,000	6.8	13	54.7
Clay products	65,226	4,802	7.4	10	50.0
Nonshifting industries:					
Perfumes, cosmetics, etc	10,158	1,296	12.8	5	11.9
Silverware and plated ware	11,361	1,155	10.2	4	40.5
Millinery	21,560	1,877	8.7	4	48.7
Engraving, steel, copperplate and wood	7,831	580	7.4	6	46.5
Trunks, suitcases, bags, etc	8,708	462	5.3	8	46.7
Concrete products	12,840	280	2.2	14	33.9
Ice, manufactured	18,705	368	2.0	17	19.8
Marble, granite, slate, etc	20,816	396	1.9	12	47.2
Median shift ratio			10.2		

To simplify the study, those industries in which the volume of shifts fell below a certain level were classified as nonshifting. For the 139 industries the median number of wage jobs in shifts was 2,516. All industries with shifts of less than the median number were considered as nonshifting industries, unless the shift ratio was in the top quartile. Similarly, industries with shifts greater than the median number were regarded as shifting industries, unless the shift ratio was in the bottom quartile.[8] On this basis there were 67 nonshifting and 72 shifting industries. (See table 4.) Since, by definition, the shifting industries were (with few exceptions) those in which the number of wage jobs in shifts exceeded 2,516, it is natural that the shifting industries tended to be the larger ones.[9] These industries also expanded to a greater extent than did the entire group of industries.[10]

There are two other important respects in which there were differences between the shifting and nonshifting industries. The first relates to the degree of geographic scatter. (See table 5.) A rough, but adequate, measure for each industry is the number of leading States that account for at least 75 percent of total wage jobs. The higher the coefficient, the higher the degree of scatter.[11] The most significant fact revealed by the distribution of this measure is the large proportion of nonshifting industries which were concentrated in a few States or which were significantly dispersed. Thus, 6 industries had a coefficient of either 1 or 2, and 17 had a coefficient of 10 or higher. Among the shifting industries, on the other hand, only one industry had a coefficient of 1 or 2, and only 8 industries had a coefficient of 10 or higher. In other words, the shifting industries were to lesser degree highly concentrated or widely distributed. As will appear below, this difference reflects in part the operation of particular location factors.

The other noteworthy respect in which the two groups of industries differ is in the ratio of wages to value added (table 6). A frequency distribution of these ratios indicates that the ratio tended in general to be higher for the shifting industries,[12] suggesting that differentials in labor cost were probably a factor in many shifts.

TABLE 4.—*Absolute and relative number of wage jobs in shifting industries and absolute and relative number of shifting industries classified by percent change in wage jobs, 1929–37*

Industries, by percent change in wage jobs, 1929–37	Total number of wage jobs 1929	Number of wage jobs in shifting[1] industries, 1929	Wagejobs in shifting industries as percent of total 1929	Total number of industries	Number of shifting industries	Shifting industries as percent of total
+24.0 or over	998,979	905,658	90.6	29	21	72.4
+6.0 to +23.9	1,690,241	1,332,912	78.9	26	17	65.4
+1.1 to +5.9	1,150,761	760,040	66.0	21	10	47.6
+1.0 to −1.0	554,594	472,307	85.2	7	2	28.6
−1.1 to −11.0	1,594,824	1,174,487	73.6	25	9	36.0
−11.1 to 20.9	719,279	513,570	71.4	14	4	28.6
−21.0 or over	1,086,299	917,112	84.4	17	9	52.9
All industries	7,794,977	6,076,086	77.9	139	72	51.8

[1] For definition of shifting industries, see footnote 4, table 3.

TABLE 5.—*Distribution of 139 selected industries according to degree of geographic scatter* [1]

Coefficient of scatter	Number of industries		
	Total	Shifting industries	Nonshifting industries
1	1		1
2	6	1	5
3	9	5	4
4	17	8	9
5	23	17	6
6	20	13	7
7	14	5	9
8	9	7	2
9	15	8	7
10	4	3	1
11	5	1	4
12	4		4
13	2	1	1
14	2		2
15	4		4
16			
17	2	1	1
18	2	2	
Total	139	72	67

[1] See table 3 for definition of coefficient of scatter, and shifting and nonshifting industries.

TABLE 6.—*Distribution of 139 selected industries by ratio of wages to value added by manufacture, 1937*

Type of industry	Total number of industries	Percent of industries by ratio of wages to value added by manufacture				
		10 to 19.9	20 to 29.9	30 to 39.9	40 to 49.9	50 and over
Shifting industries [1]	72	2.8	5.6	20.8	43.0	27.8
Nonshifting industries [1]	67	13.4	13.4	17.9	41.9	13.4

[1] For definition of shifting and nonshifting industries see table 3.

[8] There was one exception to the application of this procedure. In foundry and machine shop production, wage jobs in shifts numbered 27,400, the sixth largest shift. Although its shift ratio was only 6.3 percent, because of the absolute size of the shift, it was regarded as a shifting industry.

[9] This is evident from table 4, for in each group the shifting industries accounted for an appreciably larger proportion of the number of wage jobs than of the number of industries.

[10] While 55 percent of the 139 industries were classified as expanding, as many as 68 percent of the shifting industries were so classified.

[11] It might appear that a coefficient of 36 (or three-fourths of the States) would represent a uniform scatter. Actually, this is not the case, for the first 14 States in population (beginning with New York) contain 75 percent of the national total, and an industry whose distribution conformed perfectly with population would therefore have a coefficient of 14 also. Inspection of table 5 shows that the modal coefficient for the 139 industries is actually only 5.

Such a crude measure obviously does not take into account the degree of scatter (or concentration) among the States representing three-quarters of the industry, but it is easy to compile and, for the purpose in hand, adequate. A more precise measure of concentration, called a coefficient of localization, has been devised by Professor P. Sargent Florence. (See ch. 5.)

[12] Thus, 8 percent of the former had ratios of less than 30 compared with 27 percent of the nonshifting industries (table 6). At the other end of the distribution, the percentages were more nearly reversed with 28 percent of the shifting industries having ratios of 50 or higher compared with 13 percent of the nonshifting industries.

Causes of Locational Shifts

Nonshifting Industries

To analyze the reasons why industries shift, it may be helpful to consider the negative side first, i. e., to discover why some industries have maintained approximately the same geographic pattern.

Among the industries that are market-oriented, some use virtually ubiquitous materials and are restricted to local markets. The products of such industries cannot be transported for long distances, owing either to their perishability or to their small value in comparison to bulk and weight. Accordingly, the location of these industries is bound up with the location of urban populations. Since there was no major shift in the urban population between 1929 and 1937, these industries moved little and continued to be widely scattered.

The market for each producer of ice, ice cream, and bread, for example, is narrowly circumscribed, mainly because of perishability of the product, and in recent years has shifted little. In this category, too, may be placed the printing and publishing of newspapers and of job printing inasmuch as their products are also, in a special sense of the word, perishable. The printing service industries tend to be closely associated geographically with printing itself. Consequently lithographing, engraving (including photo-engraving and steel, copperplate, and other engraving), and the production of signs and advertising novelties fall also among the nonshifting industries.

Illustrative of those industries with highly restricted markets due to the small value of the product in relation to its bulk and weight are bags, other than paper, not made in textile mills; wood preserving; cement, clay products, ordinary grades of marble, granite, slate, etc.; concrete products; mattresses and bedsprings; sheetmetal work; yellow pine cooperage material; bulky feeds prepared for animals and fowls. It should be noted that for all but 3 of the 20 industries with rather narrowly circumscribed markets there was a considerable scatter (coefficient of 9 or higher). Nor were the three excepted industries, those subsidiary to printing publishing, highly concentrated (coefficients of 6 or 7).

The nonshifting industries that are market-oriented include a number for which the markets are not closely delimited, since the products can be economically transported over major marketing areas. Shifts in these industries would be largely dependent on shifts in the major marketing areas or on rather substantial reductions in transportation costs, neither of which happened during the period under study. Markets here may consist either of the ultimate consumer or of other industries. The bulk of both are in the same geographical areas; i. e., in the manufacturing belt of lower New England, Middle Atlantic, and Middle States with the addition of California. Accordingly, the industries in this category continued to carry on much the larger share of their production in those States. They comprised paints; sporting and athletic goods; toys, games, and playground equipment; trunks, suitcases, and bags; forgings; perfumes and cosmetics; drugs; plumbers' supplies; lighting equipment; cordage and twine; machine-tool accessories; screw machine products and wood screws; bolts, nuts, and washers, etc.; tools, not including edge or machine tools. For these 15 industries, the measure of scatter varied from 5 to 9, a sufficient number of States for the bulk of each industry to allow it to serve major marketing areas.

Still other nonshifting industries, all of them consumers' goods industries, were market-oriented but highly concentrated, partly because the products could be transported long distances and partly because it has been an advantage to operate close to important style centers. The development of a specialized labor supply at these long-established locations is another factor militating against shifts. In this category might be placed leather gloves and mittens; fur goods; hats, fur felt; millinery; and corsets and allied garments. Each of these five industries in 1929 was concentrated in a few States (scatter coefficients from 2 to 4; see table 3). Industries, such as cotton small wares and knit cloth, which produce materials largely for the needle trades, find it advantageous to be located close to the center of these trades. Despite the considerable amount of shifting in the needle trades, metropolitan New York has remained the most important center largely on account of the style factor. Somewhat similar considerations have kept cut stock and findings near the boot and shoe industry.

Cane sugar refining, with a coefficient of 4, is restricted, in the main, to a few major market areas because the locations providing good harbor facilities for receiving raw materials from abroad are, in most cases, large centers of population. Since there had been no shift in major markets there has been no change in the location of the refineries.[13]

A number of the nonshifting industries are primarily raw-material oriented. Since the sources of these materials remained the same, the industries did not shift. In some cases the materials were scattered, as in flour milling (with a scatter coefficient of 15), or wood, turned and shaped (coefficient 12) or miscellaneous food preparations (coefficient 10). Other industries in this category were fertilizers (coefficient 9), leather, coke, and

[13] Sugar refining based on domestic cane is restricted mainly to Louisiana.

cottonseed products (coefficient 7). In other cases, however, the sources were relatively concentrated, as in blast furnaces and cast iron pipe, as well as in the smelting and refining of copper and zinc (industries for which the coefficient was either 4 or 5). In the two last-named cases the establishments are found either in the mining areas or in cities with harbor facilities to receive ore from abroad, that is, in locations determined by either raw materials or markets. Petroleum refining has also been subject to the same dual locational considerations. It has been carried on either at the oil fields, termini of pipe lines, or at harbors that can accommodate tanker fleets and are also excellent distribution centers for the refined products.

Finally, the nonshifting industries included some that were geographically concentrated, mainly because the demand for their output could be supplied by relatively few establishments and the products themselves were easily transportable. In this category were photographic apparatus [14] with a concentration in one State; optical goods, typewriters and parts, and locomotives not made in railroad repair shops, with concentrations in two States; clocks and watches and sewing machine attachments, with concentrations in three States; and silverware and plated ware, with a concentration in four States. This series of industries, especially the watch and optical goods manufactures, is also dependent upon a skilled labor supply which has remained highly localized, a factor which tends further to make the location of the industries self-perpetuating. There is little evidence of locational shifts in these industries, even over longer periods than the one here under survey.

In résumé, then, the 67 nonshifting industries comprise those which serve markets highly restricted geographically, those that must remain oriented toward the major consumers' and industrial markets (which did not shift), those based on raw materials (the location of which remain unchanged), and those dependent on very specialized skills that could not be readily developed elsewhere.

Shifting Industries

It is evident from the foregoing that the shifting industries were those that were tied either to labor which became cheaper in new locations because of technological changes or otherwise; or to raw materials that shifted their location; or to specialized markets that were altered either in character or situation. It is necessary to examine in some detail the geographic changes involved in movements of particular industries for whatever clues they provide to the specific reasons underlying the shifts themselves. These changes are described in terms of the types of shifts, defined above as absolute and relative inward shifts and absolute and relative outward shifts.

Labor-Cost Differentials

As already noted, the ratio of wages to value added varies significantly between the shifting and nonshifting industries. Obviously, every industry with a high ratio labor cost can not seek a location with lower unit labor costs, for some industries are more closely tied to raw materials or markets; nor do alternative locations with lower unit labor costs always exist, for some industries are dependent upon highly specialized skills. Nevertheless, the higher the ratio of wages to "value added," the greater will be the pressure upon labor costs. One way of relieving such pressure is to go where unit labor costs are lower. Thus, in more than one-quarter of the shifting industries, 19 out of 72, it would seem that differentials in labor cost were the most important single factor in determining the shifts, though not necessarily in determining the original location. These 19 industries, moreover, included no less than 9 with the ratio of wages to "value added" of 50 or higher.

Low-wage areas, of course, are relative and vary with the given industry. Thus, the older New England textile centers were high-wage areas for the cotton goods industry but low-wage areas for silk and rayon or for knit goods. In general, however, low-wage areas included certain parts of New England, smaller communities of New Jersey and Pennsylvania not too distant from New York City, and the Southeast.

Shifts to the latter region have received the most attention. This would seem justified, at least for those 19 industries that shifted primarily to take advantage of differentials in labor cost. The more important instances [15] in those 19 industries are presented by States and type of shift in tables 7, 10, and 13. In the 2 former tables are the 12 industries in which the shifts to the South were more or less prominent. While the shifts in the first three industries listed (cotton, furniture, and hosiery) were almost entirely southward, important shifts in the remaining 9 industries occurred into northern as well as into Southern States.

Perhaps most conspicuous were the locational changes in the cotton goods industry, which are well known. Although the movement southward from the New England and Middle Atlantic States has been

[14] Since the manufacture of photographic apparatus has been largely controlled by one company, the location of the industry has not been subject to competitive forces. This does not imply that this location has not been economically sound.

[15] Shifts involving 750 or more wage jobs in any State.

TABLE 7.—*Major locational shifts in labor oriented industries that shifted predominantly to the Southeast, 1929–37, by State and type of shift*[1]

Industry	Percent change in wage jobs in United States, 1929–37	Outward shifts			Inward shifts		
		State	Number of wage jobs in—		State	Number of wage jobs in—	
			Absolute shifts	Relative shifts		Absolute shifts	Relative shifts
Cotton goods	−0.6	Massachusetts	27,899		Georgia	14,202	
		Rhode Island	10,068		North Carolina	12,865	
		New Hampshire	6,524		Alabama	10,109	
		Pennsylvania	3,951		South Carolina	9,701	
		New Jersey	1,775		Virginia	4,375	
		New York	1,170		Maine	1,598	
		Connecticut	1,662		Texas	917	
					Mississippi	808	
Furniture	−12.1	Michigan	3,536		North Carolina	3,069	
		Illinois	3,195		Virginia	2,979	
		New York	1,788		Ohio	1,429	
		Wisconsin	1,086		South Carolina	1,026	
		Indiana	1,031				
Hosiery	+16.1	Pennsylvania	10,224		North Carolina	11,261	
		Wisconsin	2,721		Georgia	2,988	
		Tennessee		1,006	Virginia	1,483	
		New York	1,001		Mississippi	960	
		New Hampshire	779				
Silk and rayon	−10.4	Pennsylvania	13,940		North Carolina	10,803	
		New Jersey	8,983		South Carolina	7,000	
		Connecticut	3,749		Massachusetts	5,780	
		New York	2,580		Virginia	2,551	
					Maine	1,622	
					Rhode Island	1,539	

[1] Major shifts are those that involve 750 or more wage jobs in any State. For a definition of types of shift, see p. 87.

TABLE 8.—*Regional occupational differentials for males in wood household furniture industry, October 1937*

Occupation	Average hourly earnings	
	North	South
Assemblers, miscellaneous skilled	0.576	0.408
Upholsterers	.810	.515
Sprayers	.567	.393
Sanders, belt	.514	.353
Sawyers, band	.557	.418
Craters, packers, and wrappers	.475	.312
Polishers and rubbers	.542	.338
Helpers, woodworking machine operators	.374	.278
Laborers, general	.412	.285

Source: *The Wage and Hour Structure of the Furniture Manufacturing Industry*, October 1937. U. S. Bureau of Labor Statistics Bulletin No. 669 (1940) p. 72.

underway for several decades, it continued in substantial volume during this period. The wage rate differentials that underlay these changes have been adequately analyzed elsewhere.[16]

In furniture making, a nationally declining industry in terms of wage jobs, the outward shifts, with the exception of those from New York, were mainly confined to the Middle Western States of Michigan, Illinois, Wisconsin, and Indiana. There was an absolute inward shift, however, into Ohio, not because of differentials in labor cost but rather because of the increased use of metal office furniture. In the manufacture of wood furniture the absolute inward shifts were larger and occurred in the Southeast. The extent of the regional differential in labor cost, as reflected in average hourly earnings for selected occupations in October 1937, is set forth in table 8.

[16] See chap. 11, as well as A. F. Hinrichs and Ruth Clem, "Historical Review of Wage Rates and Wage Differentials in the Cotton Textile Industry," *Monthly Labor Review*, vol. 40, No. 5, May 1935, p. 1171.

TABLE 9.—*Average hourly earnings in the full-fashioned hosiery industry by districts (all occupations combined) for specified years*

Producing district	1929[1]	1938[2]
NORTH		
Philadelphia	$0.800	$0.720
Reading	.696	.696
Other Pennsylvania	.589	626
West	.614	.733
New York, New Jersey, and New England	.818	.637
SOUTH		
North Carolina	.383	.623
Other South	.349	.545

[1] George W. Taylor and L. P. Goodman, *Recent Changes in Hourly Earnings of Employees in the Hosiery Industry*, 1936, p. 9.
[2] Unpublished figures from U. S. Department of Labor, Bureau of Labor Statistics.

It will be noted that in the hosiery industry, as in the furniture industry, the largest inward shifts were into North Carolina. By far the largest outward shift was from Pennsylvania, chiefly out of Philadelphia and Reading. The wage differentials (average hourly earnings) on which the shifts appear to have been based are presented in table 9.

In the remaining nine industries reported in tables 7 and 10, movements into the South figured prominently in shifts but not more so than some of the Northern States. The decline in the silk and rayon industry was confined to the production of silk woven goods, which was occasioned by the development of rayon as a cheaper substitute. The rayon weaving industry developed not in the silk centers of New Jersey, Pennsylvania, and New York, but partly in the new textile centers of the South and partly in the old textile centers of New England, in both of which labor could be secured at cheaper rates than in the silk industry areas. The converse trends in the two industries thus brought about substantial outward shifts

from the three Middle Atlantic States and inward shifts to New England and the South.[17]

The manufacture of rayon and allied products expanded so rapidly that the relative outward movements in the industry were substantially larger than the absolute outward shifts. In fact, the only such shifts of consequence were from New York and Ohio. Relative outward shifts, i. e., expansion at lesser rate than the entire industry, were found in Pennsylvania, Virginia, and Tennessee. The most important inward shifts were in Maryland, involving about 6,800 wage jobs, and nearly 1,600 in West Virginia. In the Southeast there were inward shifts of about 1,500 in North Carolina and 550 in Georgia. These changes appear to be related to regional differences in wage costs (table 11).

Shifts in the manufacture of woolen goods were mainly among the New England States and to the Southeast, with small shifts in both directions in the Middle Atlantic and Middle States. These movements appear to have resulted from attempts to cut wage costs.

Somewhat similar were developments in men's clothing or certain branches of this industry group, more particularly the less stylized products such as shirts, work clothing, washable trousers, and accessories. Although this was an expanding industry,

[17] The decline in the Middle Atlantic States is somewhat overstated because of a change in classification. Dyeing and finishing departments in silk and rayon mills were classified in the dyeing and finishing industry in 1937 but not in 1929.

TABLE 11.—*Average hourly earnings in rayon and other synthetic yarn manufacturing, by occupation and region, 1932* [1]

Occupation	New England District 1	Middle East District 2	Southeast District 3
Spinners, male	0.422	0.551	0.428
Twisters and Throwers, female	.271	.316	.248
Reelers and Lacers, female	.266	.359	.278
Winders, Cone, Quill, Cop, or Bobbin, female	.261	.289	.263
Skein Inspector, female	.252	.317	.302
Truckers and Handlers, male	.291	.326	.297

Source: "Wages and Hours of Labor in Rayon and other Synthetic Yarn Manufacturing, 1932," U. S. Bureau of Labor Statistics, *Monthly Labor Review*, March 1933.

[1] The only data available on labor cost differentials are average hourly earnings in 1932. Three districts are distinguished: District 1 includes 1 plant in each of New Hampshire, Massachusetts, Rhode Island, and Connecticut; District 2 refers to 2 plants in New York, 2 in Ohio, and 1 in Pennsylvania, and 1 in Delaware; District 3 covers 1 in Maryland, 4 in Virginia, 3 in Tennessee, 1 in North Carolina, and 1 in Georgia.

TABLE 10.—*Major locational shifts in labor-oriented industries that shifted to the southeast and northeast, 1929 to 1937, by State and type shift* [1]

Industry	Percent change in wage jobs in United States, 1929–37	Outward shifts: State	Outward: Number of wage jobs in—Absolute shifts	Outward: Number of wage jobs in—Relative shifts	Inward shifts: State	Inward: Number of wage jobs in—Absolute shifts	Inward: Number of wage jobs in—Relative shifts
Men's clothing	+14.0	New York	20,252		Pennsylvania	6,327	
		Illinois	7,296		Tennessee	5,775	
		Wisconsin	1,511		Mississippi	5,490	
		Minnesota	1,480		Virginia	3,776	
		Ohio		1,098	Massachusetts	3,103	
		Maryland		1,034	Georgia	2,580	
		Michigan	792		Connecticut	2,072	
					Kentucky	1,242	
					Alabama	1,223	
					North Carolina	977	
					South Carolina	909	
Boots and shoes, other than rubber.	+4.8	Massachusetts	11,017		Maine	3,160	
		New York	5,082		New Hampshire	2,471	
		Wisconsin	1,206		Tennessee	2,246	
		Kentucky	1,148		Pennsylvania	2,012	
					Ohio	1,964	
					Virginia	1,682	
					Illinois	1,230	
					Georgia	877	
					New Jersey	846	
Rayon and allied products	+40.9	Virginia		3,845	Maryland	6,791	
		Pennsylvania		2,356	West Virginia	1,561	
		New York	2,206		North Carolina	1,473	
		Ohio	1,298				
		Tennessee		1,038			
Woolen goods	+15.0	Massachusetts	4,413		Vermont	1,855	
		Connecticut	1,116		Georgia	1,477	
		Rhode Island	875		North Carolina	1,354	
		Maine		855			
Cigars	−33.6	Ohio	1,470		New Jersey		2,240
		New York	1,383		Florida		1,952
		Tennessee	1,235		South Carolina	1,581	
		Kentucky	853		Pennsylvania		1,018
		Indiana	804				
Knitted underwear	−3.8	New York	3,868		Tennessee	1,844	
		Massachusetts	850		Pennsylvania	1,617	
		Connecticut	762		North Carolina	1,420	
					Michigan	750	
House furnishings and fabricated textiles.	+43.7	New York	2,861		Georgia	1,324	
					Michigan	822	
Gloves and mittens, cloth	+36.6	Ohio	1,144		Georgia	884	
		Indiana	978		New York	614	

[1] Major shifts are those that involve 750 or more wage jobs in any State. For a definition of types of shift, see p. 87.

there was an absolute outward shift of more than 20,000 wage jobs from New York, mainly from New York City. Midwestern centers in Illinois, Wisconsin, and Minnesota also sustained outward shifts. The major expansion was in areas of lower wage costs in the Southeast, New England, and the Middle Atlantic States not far removed from metropolitan New York. Still another variation in pattern was provided by the manufacture of knitted underwear, a nationally declining industry in terms of wage jobs. In this instance, though the largest outward shift, 3,900 wage jobs, was from New York, there were also outward shifts from Massachusetts, Connecticut, and New Jersey, ranging from 400 to 850 wage jobs. In keeping with the more usual pattern for these industries, there was an absolute inward shift of some 1,600 wage jobs into Pennsylvania, as well as expansion in several States of the Southeast, such as Tennessee and North Carolina, with lesser shifts into Alabama and Virginia. In the Middle Western States the shifts were mixed and small. Some indication of the character of wage differentials that existed as late as September 1938 is given by the data in table 12.

TABLE 12.—*Average hourly earnings for skilled workers and all workers in the knitted-underwear industry by region, September 1938*

Region	All workers	Skilled workers
New England and New York [1]	0.423	0.594
Pennsylvania	.379	.515
Middle Western States	.475	.613
Southern wage area	.330	.445

Source: *Hourly Earnings in Knit-Goods Industries (Other than Hosiery)*, September 1938, Bureau of Labor Statistics, November 1939, p. 8.

[1] Includes New Jersey.

In the manufacture of boots and shoes, other than rubber, shifts to the Southeast were of somewhat lesser importance but still considerable. Of more importance was the shift within New England from high-wage to low-wage areas. Thus, from the shoe centers of Massachusetts there was an outward shift of 11,000 wage jobs. Half of this number could be accounted for by an inward shift of 3,200 wage jobs into Maine and 2,500 wage jobs into New Hampshire. Much the same thing on a smaller scale happened in the Middle Atlantic States, where an outward shift of 5,100 wage jobs from New York was partially offset by an inward shift of 2,000 wage jobs to Pennsylvania. There were also cross-currents in the Middle Western States with inward shifts to Illinois and Ohio of 1,200 and 2,000 wage jobs respectively, and an outward shift of 1,200 from Wisconsin. In the Southeast the largest inward shift was to Tennessee, some 2,200 wage jobs, while there was an outward shift of half this number from Kentucky. There were very definite beginnings of the industry in Virginia and Georgia.[18]

The cigar industry was among those with the largest relative decline in this period, and the movements were largely absolute outward shifts or relative inward shifts, i. e., the percent decline in a given State was less than that for the entire industry. The only absolute inward shift, that into South Carolina, included nearly 1,600 wage jobs. A relative inward shift of somewhat larger proportions (1,952 wage jobs) occurred in Florida. In both States the presence of a labor supply willing to accept the very low wages paid for making cigars by hand probably accounted for the shifts. Some absolute outward shifts occurred in the Southeast such as 1,200 from Tennessee and 850 from Kentucky. The largest outward shift, however, was from New York, involving almost 1,400 wage jobs. Owing to the location of a large proportion of the mechanized plants in New Jersey and Pennsylvania there were relative inward shifts of 2,200 in the former and 1,000 in the latter.

The last two industries of the series under consideration—namely, house furnishings and fabricated textiles, and cloth gloves and mittens—were relatively unimportant. In the former, the largest shift was out of New York, nearly 2,900 wage jobs, while the largest inward shift, some 1,300, was into Georgia. Much smaller inward shifts occurred into Tennessee and Kentucky. The outward shifts in the making of cloth gloves and mittens were from Ohio and Indiana, while small gains were registered in Georgia, New York, and Illinois.

There were seven other industries for which the movements appear to be labor-motivated but for which shifts to the Southeast were negligible or nonexistent (table 13). The most important of these was women's clothing, one of the industries in which the percent increase in wage jobs between 1929 and 1937 exceeded 24 percent. As a consequence, the absolute inward shifts occurred in the main by virtue of relative outward shifts rather than absolute outward shifts. Indeed, the latter were found in any substantial number only in Ohio, largely Cincinnati, and Maryland, respective shifts of 3,200 and 2,000 wage jobs. These are to be compared with the relative outward shift (percent increase for an industry in a given State less than the percent increase for the entire industry) from New York, chiefly New York City, of nearly 17,000 wage jobs. By comparison, the other relative outward movements were minor. The absolute inward shifts were to the low-wage areas of New England and to

[18] For a discussion of the importance of labor costs in these shifts see E. M. Hoover, Jr., *Location Theory and the Shoe and Leather Industries*, Harvard University Press, Cambridge, 1937, p. 171.

TABLE 13.—*Major locational shifts in labor-oriented industries that shifted to the Northeast and Middle States, 1929 to 1937, by State and type of shift* [1]

Industry	Percent change in wage jobs in United States, 1929–37	Outward shifts			Inward shifts		
		State	Number of wage jobs in—		State	Number of wage jobs in—	
			Absolute shifts	Relative shifts		Absolute shifts	Relative shifts
Women's clothing	+29.5	New York		16,686	New Jersey	11,953	
		Ohio	3,179		Pennsylvania	5,665	
		Maryland	1,996		Connecticut	3,831	
		Illinois		1,738	Massachusetts	2,019	
		Missouri		1,438	Michigan	842	
		Washington	889				
Leather goods, handbags, etc.[2]	+26.6	New York		2,259	Connecticut	1,321	
					New Jersey	1,269	
					Massachusetts	1,146	
Bookbinding and blankbook making.	+2.3	do	2,831		Illinois	965	
					New Jersey	932	
Knitted outerwear	+1.2	do	2,211		Pennsylvania	1,020	
Wool carpets and rugs	−5.7	Massachusetts	2,327		New York	1,349	
		Pennsylvania	1,184		New Jersey	1,062	
Refrigerators	+89.8	New York	3,797		Pennsylvania	3,350	
	+89.8	Ohio		1,821	Michigan	2,683	
					Illinois	1,449	
Rubber goods [2]	+19.8	Massachusetts	1,918		Rhode Island	1,107	
		New York	1,640		Illinois	996	
		Connecticut	1,300				

[1] Major shifts are those that involve 750 or more wage jobs in any State. For a definition of types of shift, see p. 87.
[2] Not elsewhere classified.

the Middle Atlantic States not too far removed from New York City, the major style and distributing center.

Very similar, but on a reduced scale, was the experience in the manufacture of leather goods and handbags. In this industry, there was an important relative outward shift from New York and smaller absolute outward shifts from several Middle States, with major absolute shifts into New Jersey, Pennsylvania, Connecticut, and Massachusetts. Knitted outerwear was characterized by the same movement, except that the outward shift from New York was an absolute one. In bookbinding and blank-book making, there was another major absolute shift from New York, where the printing trades generally were highly unionized. In this instance, however, the inward shifts were to Illinois, Indiana, and New Jersey. Shifts in the fabrication of wool carpets and rugs, it will be noted, occurred within the established centers of the industry.[19]

The more important shifts in the manufacture of refrigerators also seem to have been brought about by labor-cost differentials. The two shifts of major consequence were an outward one of 3,800 wage jobs from New York, presumably Schenectady, and an inward shift of 3,350 into Pennsylvania, mainly Erie, where wage costs were somewhat lower. Lastly, there were movements in the fabrication of miscellaneous rubber goods, which expanded on a Nation-wide basis. The absolute outward shifts were from older centers in Massachusetts, Connecticut, and New York. In Ohio, also a center, there was a relative outward shift of some 300 wage jobs. The inward shifts, of moderate size, were to States that adjoined or were near the established centers.[20]

Changing Location of Raw Materials

Interstate movements in 14 industries can be attributed primarily to shifts in the location of raw materials, including 6 that have been bound to our forest resources (table 14). The most obvious of these was the processing of lumber, an industry in which the decline exceeded 20 percent. As might be expected in such a situation, wage jobs in absolute inward shifts were not very much more numerous than those in relative inward shifts, 30 percent and 21 percent, respectively, of all wage jobs involved in shifts. By far the more important outward shifts were from States in the Southeast. Secondary outward shifts occurred in the Great Lakes area of Wisconsin and Minnesota.

The absolute gains were even more widely scattered regionally. The largest, some 9,100 wage jobs, occurred in Oregon. The Southeast was represented by a shift of nearly 2,900 wage jobs into Virginia while the only other absolute inward shift was into Maine. Almost as scattered were the relative inward shifts (i. e., where the percent decline of the industry in a given State was less than for the industry on a country-wide basis). While the larger shifts of this type were in the Far West (Washington and Cali-

[19] For a discussion of the role of labor-cost differentials in these shifts, particularly the decline of the industry in Philadelphia, see A. H. Cole and H. F. Williamson, *The American Carpet Manufacture, A History and an Analysis*, Harvard Economic Studies, vol. LXX, Harvard University Press, Cambridge, Mass., 1941, pp. 154–156 and Gladys L. Palmer, *Union Tactics and Economic Change*, University of Pennsylvania Press, Philadelphia, Pa., 1932, pp. 5–22.

[20] For a discussion of the importance of labor-cost differentials in this branch of the rubber goods industry see John Dean Gaffey, *The Productivity of Labor in the Rubber Tire Manufacturing Industry*, Columbia University Press, N. Y., 1940, p. 170.

fornia), they were also appreciable in the Southeast (Florida and North Carolina).

In a related industry, planing mill products, there was also a rapid decline and roughly equal absolute and relative inward shifts. The movements in this industry and those in lumber, however, did not appear to be highly correlated; for example, in planing mill products there were very few important shifts. Thus, while shifts of more than 250 wage jobs occurred in 19 States, they exceeded 1,000 only in 5 States and in no State involved as many as 2,000 wage jobs. The regional scatter of the few significant shifts is indicated in table 14.

In the manufacture of wooden boxes, another nationally declining industry, shifts were typically small and widely scattered. Of the 15 States in which shifts occurred, only 2 had movements amounting to more than 1,000 wage jobs. The only important absolute gains were made in Florida and Georgia, while small losses were found in New England (Massachusetts and Maine), Middle Atlantic (Pennsylvania and Maryland) and Middle Western States (Ohio, Wisconsin, and Missouri).

Shifts in the processing of pulp, wood, and other fiber, were also characteristically small and scattered. Only 3 of the interstate shifts in this expanding industry involved more than 1,000 wage jobs. Two of these were absolute outward, from New Hampshire and New York; the third was inward, into Washington. In the Southeast the only absolute outward shift was from North Carolina, some 900 wage jobs, while small inward shifts ranging from 270 to 700 wage jobs took place in seven States of the region.

Shifts in forestry resources affected locationally the manufacture of the primary paper products. As in the case of other wood products industries, many States were represented, but the shifts from a single State were moderate or small. These were primarily restricted to the Northeast, with the exception of Pennsylvania and Maryland, where gains were small. The larger inward shifts, however, occurred mainly in the Southeast and Far West. In the former region the shifts aggregated nearly 3,500 wage jobs (presumably chiefly in the manufacture of kraft paper) but they were scattered over eight States and the largest single shift did not exceed 850 wage jobs. Each of the three States in the Far West had an inward shift, with the largest one in Oregon involving just over 800 wage jobs.

Since paper bags are manufactured from kraft paper, it was to be expected that the latter would shift along with kraft paper. Accordingly, the single most important shift was to Alabama, almost 800 wage jobs, with one-third that number going to Georgia.

The remaining eight industries reflecting geographic changes in raw materials are shown in table 15. In wholesale meat packing, a nationally expanding industry, the development of new grazing areas in the North and Far West as well as in the South brought a concomitant shift at the expense of the older centers. Thus the major absolute outward shifts were from Illinois, Kansas, and Nebraska. The largest inward shift was in California and amounted to nearly 1,400 wage jobs, though both the Southeast and Southwest were favored almost equally.

Since the raw materials for the canning and preserving of fruits and vegetables are perishable, the can-

TABLE 14.—*Major locational shifts in specified industries based on forest resources, 1929–37, by State and type of shift* [1]

Industry	Percent change in wage jobs in United States, 1929–37	Outward Shifts			Inward Shifts		
		State	Number of wage jobs in—		State	Number of wage jobs in—	
			Absolute shifts	Relative shifts		Absolute shifts	Relative shifts
Lumber products	−22.7	Mississippi	6,722		Oregon	9,115	
		Wisconsin	3,098		Washington		3,340
		Alabama	2,769		Virginia	2,888	
		Louisiana	2,638		Florida		1,920
		Georgia	1,281		North Carolina		1,138
		South Carolina	1,137		Maine	1,118	
		Minnesota	973		California		1,109
		Tennessee	873				
Planing mill products	−25.9	New York	1,900		Washington	1,501	
		Ohio	1,322		Iowa	1,219	
		Pennsylvania	867		Virginia	1,060	
Wooden boxes	−15.0	Missouri	818		Florida	1,892	
					Georgia	1,118	
Pulp, wood and other fibre	+9.2	New Hampshire	1,307		Washington	1,704	
		New York	1,114				
		North Carolina	927				
		Maine	832				
Paper	+7.2	Massachusetts	2,506		Pennsylvania	991	
		New York	1,453		Alabama	836	
		Maine	870		Oregon	813	
		New Hampshire	792				
Bags, paper	+48.6	Maine	792		Alabama	795	

[1] Major shifts are those that involve 750 or more wage jobs in any State. For a definition of types of shift, see p. 87.

TABLE 15.—*Major locational shifts in specified raw-material-oriented industries, 1929-1937, by State and type of shift* [1]

Industry	Percent change in wage jobs in United States, 1929–37	Outward shifts			Inward shifts		
		State	Number of wage jobs in—		State	Number of wage jobs in—	
			Absolute shifts	Relative shifts		Absolute shifts	Relative shifts
Meat packing wholesale	+4.1	Illinois	4,712		California	1,397	
		Kansas	1,391		Minnesota	1,317	
		Nebraska	1,273		Georgia	1,117	
		New York	781		Tennessee	1,077	
		Missouri	778		Texas	1,024	
Canning and preserving of fruits and vegetables.	+38.6	California		5,011	do	2,457	
		New York		1,291	Florida	1,967	
		Wisconsin		1,161	Indiana	1,700	
		New Jersey		1,155	Virginia	1,205	
		Oregon		765	Illinois	1,068	
Canning and curing of fish and other seafood.	+33.9	Maine	1,042		Mississippi	1,359	
Buttons	+33.1	Iowa	989				
Cigarettes	+23.7	New York	2,235		Kentucky	2,280	
					Virginia	763	
Chemicals [2]	+24.0	do	3,328		West Virginia	2,426	
		Massachusetts	974		Tennessee	1,365	
Aluminum	+11.7	New York	1,928		Pennsylvania	1,409	
		Wisconsin	802		Tennessee	1,274	
Aircraft and parts	+63.2	New York		2,635	California	9,436	
		Michigan	2,180		Connecticut	1,535	
		New Jersey	1,373		Maryland	1,363	
		Ohio	1,075				
		Kansas	980				

[1] Major shifts are those that involve 750 or more wage jobs in any State. For a definition of types of shift, see p. 87.
[2] Not elsewhere classified.

neries must be located in proximity to the producing areas. The development of new producing areas, therefore, would call forth the establishment of new canneries in nearby localities. In recent years, canning of food products has increased considerably in the South, particularly in Virginia, Florida, and Texas, and in the Midwest, specifically in Indiana and Illinois.

The more moderate shifts which occurred in the canning and curing of fish and other seafood may be similarly explained. In this instance, there were shifts out of Maine, Massachusetts, and Washington, and shifts into Mississipi, Louisiana, and California.

Small shifts in the making of buttons, a relatively unimportant industry, can be explained by a growing use of new raw materials. The largest shift (involving nearly 1,000 wage jobs) was outward from Iowa, which has been the center for buttons made from fresh-water pearl or shell. Census data show that the quantity of such buttons produced declined from 22 to 17 million gross between 1929 and 1937 and that the drop was more than compensated for by the buttons made from synthetic materials, a section of the industry centered largely in the East. The inward shifts occurred in Massachusetts, Connecticut, New York, Maryland, and Virginia.

The cigarette industry has also continued to shift toward its raw materials, but to Kentucky and Virginia, rather than to the established locations in North Carolina. The only absolute outward shift (one of 2,200 wage jobs) was from New York.

If fuel or power be included in raw materials, shifts in chemicals may also be considered as contingent on the availability of raw materials, although the extremely heterogeneous character of the products of this industry classification makes any generalization most hazardous. It would seem that the availability of cheap natural gas in West Virginia and cheap electricity in Tennessee would explain why the largest inward shifts of this rapidly expanding industry occurred in those States. The largest sufferer was again New York.

Very probably it was cheap electricity in Tennessee and power from cheap fuel in western Pennsylvania that resulted in the expansion of the aluminum industry in those two States. Once more the only outward shift of consequence was from New York.

Climate may also be considered in the category of raw materials. At least, it was in part the relative uniformity and mildness of the California climate, making possible year-around testing and experimentation, that led to the present development of the aircraft and parts industry in that State. The inward shift to California amounted to more than 9,400 wage jobs. The factor of climate, however, would not explain the smaller movements to Connecticut and Maryland. It is rather striking that most of the absolute outward shifts took place in the Middle Western States, with the principal shift (nearly 2,200 wage jobs) from Michigan. A negative factor there appears to be a desire to avoid the high-wage areas of the automobile industry, because labor in the aircraft industry has had a much lower productivity. In this instance the outward shift from New York was only a relative one.

Market Changes

For another group of 27 industries, changes in the character of markets or in their location can be dis-

TABLE 16.—*Major locational shifts in market-oriented industries in which shifts resulted from changes in market demand, 1929 to 1937, by State and type of shift* [1]

Industry	Percent change in wage jobs in United States, 1929-37	Outward shifts: State	Outward shifts: Number of wage jobs in— Absolute shifts	Outward shifts: Number of wage jobs in— Relative shifts	Inward shifts: State	Inward shifts: Number of wage jobs in— Absolute shifts	Inward shifts: Number of wage jobs in— Relative shifts
Steel works and rolling mills	+21.5	Ohio		12,754	Michigan	15,284	
		Pennsylvania		11,054	Indiana	7,960	
		Wisconsin	2,521		Illinois	4,471	
		Minnesota	1,187		Maryland	4,420	
		New York		1,174			
		West Virginia		1,042			
		California		983			
		New Jersey		873			
		Colorado	869				
Ship and boat building	+13.0	New York	3,618		New Jersey	2,175	
		Ohio	1,074		Maryland	2,053	
		Delaware	944		Texas	1,421	
		Wisconsin	872		Pennsylvania	1,093	
					Connecticut	893	
					Maine	807	
Clay products, other than pottery.	−30.4	New Jersey	1,275		Pennsylvania	1,176	
		Illinois	1,122				
		Indiana	1,089				
Pottery	−6.6	Ohio	2,214		Michigan	797	
		New Jersey	949		West Virginia	775	
Beverages, nonalcoholic	−1.1	New York	1,755				
Asbestos products	+60.9	Connecticut	1,088				
Wallboard and gypsum products.	+55.3	New York	1,283		Indiana	809	

[1] Major shifts are those that involve 750 or more wage jobs in any State. For a definition of types of shift, see p. 87.

tinguished as the most important factor affecting shifts. In 7 of these industries, changes in the character of the markets would seem to have been the controlling factor (table 16).

There can be but little question that such was the case in steel works and rolling mills. In this 8-year period, rails and heavy steel used in construction declined in importance, while the production of sheets and strips for durable consumers goods, more notably automobiles, gained in importance. Thus, of the total production of finished rolled steel products in 1929, rails accounted for 6.6 percent, structural shapes for 11.8, and sheets and strips, 14.2. The respective percentages in 1937 were 4.1, 7.5, and 30.[21]

This alteration in demand favored the mills in some of the Middle Western States of Michigan, Indiana, and Illinois, since they were better situated to supply the consuming centers with those products needed in greater volume. An inward shift equal to that in Illinois also occurred in Maryland, but this was due mainly to the advantages of importing high-grade ore from Chile as well as to the advantage of distributing its products along the eastern seaboard by an all-water route. The outward shifts from the older producing centers of Pittsburgh and Youngstown, however, were not absolute but relative, as were the much smaller instances in New York, New Jersey, and West Virginia.

The implementation in 1937 of the United States Merchant Marine Act passed in the previous year brought much new business to the east coast shipyards, since the act provided for subsidizing the construction of ships to be used in foreign trade. The initiation of the naval building program would also have the same effect. Thus, there were inward shifts to New Jersey, Maryland, and Pennsylvania, and, to a lesser extent, to Massachusetts, Maine, and Connecticut. There was also an inward shift to the Gulf ports of Texas. Concurrent losses were felt in the Great Lakes States. The largest outward shift occurred from New York, chiefly from the New York City area.

Both the clay-products and pottery industries experienced a fall in demand for their products owing to the lag in the recovery of building construction. In the former, the only shifts of consequence were three absolute outward ones from the large centers of New Jersey, Illinois, and Indiana and one relative inward shift to Pennsylvania, important production center of high quality brick. The single important shift in the pottery industry was an absolute outward one from Ohio, where the industry's output had been weighted heavily with plumbing fixtures.

The manufacture of nonalcoholic beverages also suffered a decline in demand, the causal factor in this instance being the repeal of prohibition.[22] After the repeal, nonalcoholic beverages lost favor in the North but retained their hold in the South, a change reflected in outward shifts from Massachusetts, New Jersey, Pennsylvania, Illinois, and Wisconsin, accompanied by improvements in Virginia, North Carolina, Florida, and Texas, where the syrups were prepared and shipped

[21] *Steel*, October 17, 1938, p. 4.

[22] While nonalcoholic beverages has been a shifting industry according to our criteria, nevertheless it possessed some of the characteristics of a nonshifting industry producing for a highly localized market. The coefficient of scatter for this industry was 17.

TABLE 17.—*Major locational shifts in market-oriented industries in which shifts resulted from changes in the location of markets and/or changes in market demands, 1929 to 1937, by State and type of shift* [1]

Industry	Percent change in wage jobs in United States, 1929–37	Outward shifts			Inward shifts		
		State	Number of wage jobs in—		State	Number of wage jobs in—	
			Absolute shifts	Relative shifts		Absolute shifts	Relative shifts
Dyeing and finishing of textiles	−2.2	New Jersey	8,896		North Carolina	6,154	
		Pennsylvania	2,679		South Carolina	5,229	
		Massachusetts	1,983		Virginia	1,424	
		Tennessee	1,794		New Hampshire	978	
		Illinois	766		Alabama	788	
					Connecticut	762	
Motor vehicles	−14.0	Ohio	11,894		Michigan	27,747	
		Indiana	6,414		California	2,548	
		New York	4,498		Maryland	851	
		Wisconsin	3,132				
		Oklahoma	917				
		North Carolina	904				
		Nebraska	902				
		Massachusetts	842				
Motor vehicles, bodies and parts.	+28.7	New York	10,195		Michigan	40,294	
		Ohio	8,809		Indiana	3,710	
		Pennsylvania	6,021		Maryland	1,176	
		Tennessee	4,307				
		Wisconsin	3,890				
		Massachusetts	3,815				
		Kentucky	2,591				
		Missouri	2,027				
		New Jersey	1,995				
		Arkansas	1,022				
		Illinois		982			
Hardware [2]	+1.3	Connecticut	4,041		Michigan	5,740	
		New York	1,295		Illinois	1,835	
		Ohio	1,071				
		Pennsylvania	990				
Stamped ware and enamelled ware.	+52.7	New Jersey	2,419		Ohio	4,352	
		New York		2,384	Michigan	1,350	
		Illinois		1,617	Pennsylvania	920	
		Wisconsin	1,486				
		Maryland		906			
Glass	+17.1	Pennsylvania	3,960		Michigan	2,481	
		Indiana		1,118	Ohio	1,679	
					New York	1,061	
Mirrors and other glass products made from purchased glass.	+17.0	New Jersey	935		Ohio	1,051	
Rubber tires and inner tubes	−24.0	Ohio	3,314		Michigan	3,568	
		New Jersey	1,428		Alabama	1,184	
		Wisconsin	990		Pennsylvania	788	
					California		992
Foundry and machine shop products.	−5.2	(3)			Michigan	20,093	
					Texas	3,563	
Machine tools	−0.3	Rhode Island	1,566		Ohio	2,706	
		Vermont	902		Illinois	1,197	
Wire drawn from purchased rods.	+9.4	Indiana	3,860		Michigan	2,522	
		Illinois	1,036		New Jersey	784	
Wirework [2]	+49.5	Pennsylvania		1,186	Michigan	1,803	
		Massachusetts	1,141				

[1] Major shifts are those involving 750 or more wage jobs in any State. For definition of types of shift, see p. 87.
[2] Not elsewhere classified.
[3] Changes in classification were such as to make unwarranted the computation of outward shifts.

to bottling works in other States. Only in one southern State, Kentucky, was there any development in the alcoholic liquor industry.

The shifts in the other two industries, asbestos products and wallboard and gypsum products, were quite small, and resulted from altered market demands. In the former industry, according to census data, there was a decline in the production of asbestos textiles, offset by an increase in the production of asbestos building materials. Since each type of product was produced in different establishments, there arose locational shifts. A somewhat similar situation occurred in wallboard and gypsum products, in that there had been a falling off in the demand for plaster made from gypsum or other products, but an increased demand for wallboard, whether made from gypsum or other fibers.

Shifts in the dyeing and finishing of textiles (table 17) were clearly due to market migration. This industry is supplementary to the weaving and knitting of textiles, and when an important fraction of these moved to the Southeast, nearby establishments were set up for dyeing and finishing the less stylized products. The measurement of the shifts in this instance was complicated by changes in industrial classification. That is, in 1937 but not in 1929, dyeing and finishing departments of cotton and silk and rayon mills were included in dyeing and finishing proper. This would tend to exaggerate the magnitude of the absolute inward shifts into the Carolinas and Virginia. Still another change in classification (inclusion in hosiery in 1937 but not in 1929 of establishments that dyed and finished hosiery) tended to accentuate the volume of absolute outward shifts from New Jersey, Pennsylvania, and Massachusetts.

For a group of 10 market-oriented industries embracing automobiles and linked industries there was a

combination of changes in both character and location or markets (table 17). However, the shifts in the manufacture of automobiles themselves, which do not come within this category, must be described first. The *Census of Manufactures* has reported the manufacture of automobiles under two different industry classifications. One is "motor vehicles" defined as "all manufacturing establishments whose principal products are motor-propelled vehicles having four wheels or more, for use on highways." This reduces itself to establishments operating final assembly lines. The industry so defined declined in employment between 1929 and 1937 due mainly to increased productivity resulting from technological improvements. The latter in turn made further concentration of production economical.[23] Thus, absolute outward shifts occurred in many sections of the country, from the Southeast and Southwest regions and from certain of the Middle Western States. The evidence of increased geographic concentration of the industry is provided by the gain of 27,700 wage jobs in Michigan. The only other important inward shift, more than 2,500 wage jobs, was an attempt to develop a manufacturing center for the Far West, in California.

The industries linked to automobile manufacture would follow much the same pattern, especially motor vehicles, bodies, and parts. This branch of the industry expanded nationally owing to the increased importance of styling and gadgets, making it desirable to keep in close touch geographically with the automobile manufacturer. On the negative side was the consideration that the use of wood in bodies and parts gave way to metal and plastics. The manufacture of bodies, particularly truck bodies and parts, became less scattered, since the substitute materials are much less ubiquitous than wood. The concentration was even more striking than in the manufacture of motor vehicles. The absolute inward shift to Michigan involved as many as 40,000 wage jobs. Only two other inward shifts exceeded 1,000 wage jobs, those into Indiana and Maryland. On the other hand, the absolute outward shifts of appreciable volume were numerous and widespread.

The fabrication of hardware, not elsewhere classified, was another industry in which the shifts were affected by the automobile industry; indicative thereof was the large inward shift into Michigan. The industry was hurt at the same time by the decline in building construction; employment suffered most in Connecticut, the chief hardware manufacturing center.

Many of the products classified as stamped ware and enameled ware are also linked to automobiles. The inward shifts into Michigan, however, were exceeded by those into Ohio. The more appreciable outward shifts were both absolute and relative, the former from New Jersey and the latter from New York.

Glass making seems to have followed the automobile industry, at least into Michigan. This was the largest inward shift and involved nearly 2,500 wage jobs. The next largest shift was into Ohio, while the only other shift of importance was into New York. These last two shifts probably were not related to developments in the automobile industry. Pennsylvania showed the only substantial absolute outward shift, involving almost 4,000 wage jobs. A relative outward shift of some size from Indiana might also be noted. Closely related is "mirrors and other glass products made from purchased glass." Since the most important product of the industry and its fastest growing component has been laminated (safety) glass, the shifts out of New Jersey and into Ohio were probably connected with developments in the automobile industry.

Most of the shifting in the fabrication of rubber tires and tubes was from Ohio, presumably Akron, and into Michigan, doubtless Detroit. This was done largely to supply new cars more economically with their original set of tires. The only other inward shift of consequence was into Alabama. This resulted from the insistence of Sears, Roebuck and Co. that the Goodyear Tire and Rubber Co., under contract to supply it with tires on a cost-plus basis at the factory door, establish a plant in the South for the regional market.[24] Subsequent to 1937 a continuance of the shift out of Akron was produced by differentials in labor costs.[25]

Foundry and machine shop products may be classed with this group of industries, at least with respect to the absolute inward shifts. The heterogeneity of products that composes this classification would in itself make interpretation very difficult; furthermore, changes in classification occurred between 1929 and 1937 for which corrections could not be made. For example, industrial ice-making machinery, air compressors and dry-vacuum pumps, and duplicating, manifolding, addressing, and mail-writing machines were included in foundry and machine shop products in 1929 but were transferred to other industries in 1937. Accordingly, many of the outward shifts may reflect merely the changes in classification. The same consideration, however, does not affect the inward shifts; these are real, although the exact magnitude of the inward shifts is understated. Consequently, it is significant that there was a shift of some 20,000 wage

[23] The unionization of the industry after 1937 probably has reversed this trend.

[24] John Dean Gaffey, *op. cit.*, p. 158 and p. 162.

[25] *Ibid.*, pp. 171–175.

TABLE 18.—*Major locational shifts in miscellaneous market-oriented industries, 1929 to 1937, by State and type of shift*[1]

Industry	Percent change in wage jobs in United States, 1929–37	Outward shifts			Inward shifts		
		State	Number of wage jobs in—		State	Number of wage jobs in—	
			Absolute shifts	Relative shifts		Absolute shifts	Relative shifts
Heating and cooking apparatus, except electric.	+3.5	New York	1,442		Tennessee	1,989	
		Missouri	1,148		California	1,689	
		New Jersey	1,098		Illinois	1,042	
		Indiana	1,033		Minnesota	830	
		Ohio	989				
Tin cans and other tinware[2]	+5.2	Ohio	864		Illinois	1,150	
					Pennsylvania	834	
Cars, electric and steam railroads not made in railroad repair shops.	+1.1	Illinois	1,209		Pennsylvania	1,245	
		Iowa	1,037		California	899	
		Indiana	865		Alabama	767	
Confectionery	−15.4	New York	1,015		Illinois	3,179	
Structural and ornamental metal work.	−29.4	Ohio	1,596		California	1,584	
		New Jersey	904				
		New York	834				
Pulp goods and synthetic resins	+194.9	New Jersey		1,125	Pennsylvania	1,044	
		Delaware		1,016	Massachusetts	948	
					Michigan	785	

[1] Major shifts are those that involve 750 or more wage jobs in any State. For a definition of types of shift, see p. 87.
[2] Not elsewhere classified.

jobs (presumably machine shops and foundries proper) into Michigan, which must be attributed largely to the expansion in the same State of motor vehicles and motor vehicle bodies and parts. The only other inward shift of any consequence was into Texas, nearly 3,600 wage jobs, which was also a reflection of growth of manufactures in that State.

The machine-tool industry also services other branches of manufacturing. Accordingly, it was to be expected that the industry would shift from the Northeast to the Middle Western States along with manufactures in general.

The continued expansion of the automobile industry in Michigan during this period, as well as the presence of electrical machinery industry, probably explains the absolute inward shifts into Michigan in the manufacture of wire drawn from purchased rods and miscellaneous wirework products, both made outside of rolling mills. In each case, the gains in Michigan were the only ones of consequence. In the case of wire drawn from purchased rods, there were losses in Indiana and Illinois. In the fabrication of miscellaneous wirework the relative outward shifts were as important as the absolute. The former occurred in Pennsylvania and the latter in Massachusetts.

Sufficient data are not at hand to determine the specific reasons for the shifts in the remaining 8 industries that have been considered as oriented toward major marketing areas (table 18). In each of these industries, the individual shifts have been relatively small; however, they occurred in a relatively large number of States. The assumption of market orientation in the absence of evidence to the contrary is based on the fact that coefficients of scatter are high, ranging from 6 to 10.

Of special interest in this group of industries are the areas of expansion in the manufacture of plastic products, classified as pulp goods and synthetic resins.[26] Though still a small industry in 1937, it underwent the most rapid expansion of all 139 industries and still possesses large potentialities for development in the future. Its development was largely restricted to Pennsylvania, Massachusetts, and Michigan.

Miscellaneous Considerations

At least in general terms, 60 of the 72 industries classified as shifting have been accounted for. For the remainder (table 19) it is a moot point whether the shifts recorded were in response to changes in costs that adhere to given locations. In 5 industries, two of which declined on a national basis (textile machinery and parts and rubber boots and shoes) the shifts seemed to have resulted from an effort to consolidate production. Thus, in the manufacture of textile machinery and parts there was further concentration in Massachusetts and Maine, the losers being Rhode Island, Connecticut, New Jersey, and Pennsylvania. The manufacture of rubber boots and shoes tended to be concentrated in Connecticut, at the expense of Massachusetts, Rhode Island, and Pennsylvania.

In the making of cutlery and edge tools there was an apparent shift from Massachusetts into Connecticut, always an important center of the industry.

Much the same can be noted with respect to shifts in the worsted goods industry. In large established centers in Massachusetts and northern New Jersey the industry expanded, while the surrounding States of New Hampshire, Vermont, Connecticut, and Pennsylvania suffered absolute outward shifts. The relatively

[26] Since this industry was constituted a separate one beginning with 1931, the shifts are measured from that date.

TABLE 19.—*Major locational shifts in specified industries, 1929 to 1937, by State and Type of shift* [1]

Industry	Percent change in wage jobs in United States, 1929–37	Outward shifts			Inward shifts		
		State	Number of wage jobs in—		State	Number of wage jobs in—	
			Absolute shifts	Relative shifts		Absolute shifts	Relative shifts
Textile machinery	−6.2	Rhode Island	1,392		Maine	1,427	
					Massachusetts	998	
Boots and shoes, rubber	−28.5	do	2,170		Connecticut	3,931	
		Massachusetts	1,948				
		Pennsylvania	1,115				
Cutlery and edge tools	+12.3	Massachusetts	1,521		do	1,758	
Worsted goods	+2.1	New Hampshire	2,445		Massachusetts	3,947	
		Pennsylvania	2,002		New Jersey	1,141	
		Connecticut	1,370		North Carolina	968	
		Vermont	960				
Agricultural implements	+28.6	California	2,115		Wisconsin	6,654	
		Michigan	1,435		Iowa	1,764	
		Indiana	1,286				
		New York	1,253				
Pumps and pumping equipment.	+9.2	Massachusetts	1,432		Illinois	2,926	
		Ohio	1,358				
		Michigan	1,183				
Nonferrous alloys and products [2]	+4.8	New York	3,904		Ohio	4,936	
		Connecticut	1,347		Illinois	1,782	
		Michigan	1,149				
Electrical machinery and radios	−10.1	Illinois	7,422		Indiana	4,646	
		New York	6,355		Ohio		3,565
		New Jersey	6,252		Massachusetts	3,158	
		Pennsylvania	1,982		Missouri	3,130	
		Michigan	1,061		Connecticut	2,714	
		Iowa	762		Wisconsin	2,074	
					Maryland	1,655	
					Kentucky	1,372	
					Rhode Island	1,097	

[1] Major shifts are those that involve 750 or more wage jobs in any State. For a definition of types of shift, see p. 87.
[2] Not elsewhere classified.

small inward shift to North Carolina, however, very probably resulted from labor-cost differentials in favor of the State.

In the production of agricultural equipment, including tractors, there was evidence of concentration in the western fringe of the Middle Western States, with an increase of almost 6,700 wage jobs into Wisconsin and about 1,800 into Iowa. The outward shifts occurred not only from such widely scattered areas as New York, California, Georgia, and Kentucky, but also from several of the Middle States.

The explanation of shifts in the seven remaining industries, three of which are presented in table 19, is beset with the difficulties of changes in industrial classification. In the manufacture of pumps and pumping equipment, for example, changes in classification were such that the inward shifts might be either nominal or real, while only the size of the outward shifts can be challenged, not the fact.[27] In two other industries ("cash registers, adding and calculating machines and other business machines except typewriters" and "instruments and apparatus, professional, scientific, commercial, and industrial") however, shifts in either direction might be accounted for by changes in classification since subindustries have been added and subtracted.

The classification difficulty is much less explicit in the case of engines and turbines. This classification in both years excluded "engines made for installation in ships and boats, motor vehicles, or tractors built by the same establishments." However, with the further integration of production in motor vehicle establishments, more of the production of engines would be classified under motor vehicles than under engines and turbines. The number of engines for use in motor vehicles, for example, classified under engines and turbines declined by more than 60 percent between 1929 and 1937 while the number of motor vehicles produced declined by only 11 percent. It is undoubtedly for this reason that an outward shift (of 4,200 wage jobs) was recorded for Michigan. It is not known whether a similar situation would explain the migration (2,400) from Illinois. The inward shifts into Connecticut (1,500) New York (1,100) and New Jersey (1,600) probably represent in large part the production of engines for aircraft.[28]

In the last two of these seven industries ("nonferrous alloys and products, not elsewhere classified," and "electrical machinery, radios, and phonographs") the difficulty stems from the fact that each of the two industries embraces a heterogeneous array of products. Obviously, the entire array of products is not manu-

[27] The change in classification was occasioned by the inclusion in this industry in 1937, but not in 1929, of establishments manufacturing air compressors and dry-vacuum pumps as primary products.

[28] A somewhat similar classification difficulty also complicates the interpretation of the shifts in the industry "wrought pipe, not made in steel rolling mills." The shifts were relatively small involving 7 States with only two shifts over 1,000 wage jobs and with none over 1,100. Many of these may have resulted from changes in classification, i. e., a department in a rolling mill in 1 year may have been reorganized as an establishment in the other year, or vice versa.

factured in any State in which any one member is produced. Accordingly shifts very probably reflect variations in demand for certain of the component products entering into the total.

Summary

For purposes of summary, the 12 industries enumerated last may be excluded, since the reasons for the shifts are regarded as indeterminate. This leaves 59 industries, providing 5¼ million wage jobs in 1929, in which the locational shifts have been broadly accounted for. The most common reason found was market considerations; these accounted for 44 percent of the industries and a nearly equal percent of the wage jobs. For the most part these shifts have involved a reshifting of industry in the Northeast and Middle Western States, i. e., within the manufacturing belt, with the balance probably in favor of the Middle Western States.

Labor-cost differentials were recorded as the predominant reason for about one-third of the industries and 38 percent of the wage jobs. While much of the development of manufactures in the Southeast can be attributed to this factor, it was also a source of gain to the former textile centers of New England as well as to the smaller cities and towns in Pennsylvania, New Jersey, and Maryland.

As one would expect in an industrially mature economy, the factor of raw materials accounted for the smallest share of the locational shifts, about one-quarter of the industries and one-fifth of the wage jobs. It was pointed out that regional exhaustion of economically workable forest resources explained most of these shifts. The advantages of these shifts, in the main, have accrued to the hinterland of the major manufacturing belt. If there should be in the future a striking increase in the use of synthetic materials, further shifts of industry to the major manufacturing belt may well result.

CHAPTER 5. MEASURES OF INDUSTRIAL DISTRIBUTION

By P. S. Florence, W. G. Fritz, and R. C. Gilles*

Introduction

Some geographic sections are dominated by manufacturing; in others manufacturing activity is subordinated to other economic pursuits. As a whole, manufacturing shows a particular type of distribution in metropolitan areas, scattered smaller urban areas, and other communities. For any single manufacturing industry the geographic pattern may deviate widely among regions or among sizes of communities from that of manufacturing as a whole. Within a region or a locality the importance of the several branches of manufacturing varies widely. This chapter will describe and illustrate procedures for measuring the locational characteristics of different industries:

1. Distribution in cities of various sizes and types, in "industrial counties," or in rural areas;
2. Difference of State distribution of particular industries from manufacturing as a whole;
3. Geographic association with other industries;
4. Changes in the location of industries among States, including the extent to which the industrial structure of particular States deviates from the national pattern.

The distribution of industry might be measured according to capital investment, if reliable figures were generally available; or it could be estimated according to value of product or value added by manufacture. None of these yardsticks is ideal, nor is the one used below, the number of wage earners or "employed workers"[1] attached to each industry or occupation. The number of wage earners in any industry rises and falls from year to year with business conditions, and the labor force varies in efficiency, as well as in wage rates and living standards, from factory to factory and from territory to territory. Because of differences in labor efficiency, managerial ability, and in the use of the capital supplementing the efforts of employees, it is apparent that 10,000 workers in one industry or area may not be equivalent in productivity to 10,000 workers somewhere else. However, the use of wage earners as a unit avoids the differences in price levels that distort dollar values, as well as the differences in accounting that affect book investment in plant and equipment. In tabulating such diverse means of livelihood as wood preserving and jewelry manufacture, for example, the number of wage earners in a year of as full employment as 1939 is probably the best single common denominator.

Distribution by Types of Urban Centers

Part of the controversy over optimum industrial location revolves about the distribution of industry among types of urban areas. For consideration of this problem, available data permit effective use of seven types of areas.[2] The 33 industrial areas defined by the *Census of Manufactures* are classified into: (1) Principal cities, (2) satellite cities, (3) industrial peripheries. These 33 areas contained 54.7 percent of the manufacturing wage earners in 1939, although they cover only 97 of the 3,072 counties. The portion of the United States not included in the classification above is divided into: (1) cities of 100,000 or more inhabitants, (2) peripheries of those cities, (3) important industrial counties, and (4) all remaining areas.

The proportion of wage jobs among these 7 types of areas in 1929, for manufactures as a whole and for 50 important industries, is shown in table 1. The distribution is very different for the several industries and may mark for industries an inherent economic advantage in communities of a given type. The relative degree to which a manufacturing industry is represented among the various types of areas is shown in the table by an "urbanization quotient", which is the ratio of the proportion of workers in the area to the proportion found there for manufacturing industry generally. A quotient of *one* for any area means that there is no difference between the proportion of employees in the given industry in that area and the proportion there engaged in all manufactur-

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[1] "Wage earners" are shown for each industry by the *1939 Census of Manufactures*; "employed workers" is a term used by the *Census of Population*, the latest figures being for 1940. The latter census concerned itself with broad industry groups and included those considering themselves as belonging to the industry group and actually employed; it did not catalog a sufficient variety for present purposes. It did, however, include figures for every State where the workers associated with an occupation resided. The *Census of Manufactures* employs nearly twenty times as many categories as the *Census of Population*; but its "nondisclosure" rule requires that there be at least three establishments in any industry in any area before the figures may be shown. Further restrictions apply in certain cases. This chapter follows mainly the *Census of Manufactures*.

[2] Classification of Daniel Creamer in Carter Goodrich and others, *Migration and Economic Opportunity*, Philadelphia, University of Pennsylvania Press, 1936, p. 320 ff.

TABLE 1.—*Percentage distribution of wage jobs and urbanization quotients [1] for designated types of areas in 50 industries, 1929* [2]

[First line for each industry, percentage of United States total; second line, ratio of industry percentage to percentage for all manufactures]

	A	B	C	D	E	F	G
Industry	Principal cities	Satellite cities	Industrial peripheries	Other cities over 100,000	Peripheries of D cities	Industrial counties	Smaller detached cities and rural areas
Percentage distribution all manufactures	35.1	2.9	18.2	6.9	1.6	9.3	26.0
Canning and preserving	17.6	3.9	7.1	3.0	1.1	9.7	57.6
Quotient	.5	1.3	.4	.4	.7	1.0	2.2
Cotton goods	13.6	1.4	8.4	2.6	1.1	24.5	48.4
Quotient	.4	.5	.5	.4	.7	2.6	1.9
Dyeing and finishing	19.9	13.4	34.5	2.9	1.2	11.9	16.2
Quotient	.6	4.6	1.9	.4	.8	1.3	.6
Knit goods	31.7	2.5	15.4	8.8	1.4	11.2	29.0
Quotient	.9	.9	.8	1.3	.9	1.2	1.1
Skirts	34.4	4.7	15.0	5.1	.1	12.8	27.9
Quotient	1.0	1.6	.8	.7	.1	1.4	1.1
Silk and rayon	22.7	10.7	28.1	.4	.4	17.8	19.9
Quotient	.6	3.7	1.5	.1	.3	1.9	.8
Woolen goods	10.7	.6	31.1	1.9	.9	12.2	42.6
Quotient	.3	.2	1.7	.3	.6	1.3	1.6
Worsted goods	23.1	3.0	53.1	1.4	.5	12.4	6.5
Quotient	.7	1.0	2.9	.2	.3	1.3	.3
Men's clothing (regular shop)	73.9	1.0	4.0	6.8	.5	2.2	11.6
Quotient	2.1	.3	.2	1.0	.3	.2	.4
Men's clothing (contract shop)	65.2	4.2	16.0	2.3	.1	1.2	11.0
Quotient	1.9	1.4	.9	.3	.1	.1	.4
Women's clothing (regular shop	83.5	1.6	3.2	3.7	.1	2.3	5.6
Quotient	2.4	1.6	.2	.5	.1	.2	.2
Women's clothing (contract shop)	74.1	3.4	8.9	.5	------	5.3	7.8
Quotient	2.1	1.2	.5	.1	------	.6	.3
Boots and shoes	27.6	5.1	12.9	3.0	.3	25.5	25.6
Quotient	.8	1.8	.7	.4	.2	2.7	1.0
Pottery	7.6	.6	41.2	14.9	4.1	2.4	29.2
Quotient	.2	.2	2.3	2.2	2.6	.3	1.1
Furniture	30.5	1.3	8.3	14.2	1.2	13.6	30.9
Quotient	.9	.4	.5	2.1	.8	1.5	1.2
Tin cans and other tinware [3]	58.6	4.9	20.7	6.5	.3	4.3	5.3
Quotient	1.7	1.7	1.1	.9	.2	.5	.2
Glass	10.0	.1	25.3	.8	1.7	7.5	54.6
Quotient	.3	.03	1.4	.1	1.1	.8	2.1
Electrical machinery	43.3	7.9	30.7	3.8	1.7	6.6	6.0
Quotient	1.2	2.7	1.7	.6	1.1	.7	.2
Steel works and rolling mill products	20.0	4.1	51.4	5.3	3.7	8.3	7.2
Quotient	.6	1.4	2.8	.8	2.3	.9	.3
Steam fittings and heating apparatus	53.6	1.8	19.3	5.0	1.6	5.0	13.7
Quotient	1.5	.6	1.1	.7	1.0	.5	.5
Stoves and ranges	33.6	1.7	26.4	11.8	.4	8.0	24.1
Quotient	1.0	.6	1.1	1.7	.3	.9	.9
Rubber goods, tires, and tubes	60.5	1.9	18.5	3.6	2.2	4.5	8.8
Quotient	1.7	.7	1.0	.5	1.4	.5	.3
Foundry and machine shop products [3]	35.1	2.6	22.4	8.5	1.4	10.1	19.9
Quotient	1.0	.9	1.2	1.2	.9	1.1	.8
Engines, turbines, and tractors	26.5	3.4	24.5	1.4	.3	27.8	16.1
Quotient	.8	1.2	1.3	.2	.2	3.0	.6
Motor vehicles, bodies, and parts	53.9	.6	16.1	10.7	.6	9.1	9.0
Quotient	1.5	.2	.9	1.6	.4	1.0	.3
Motor vehicles, not including motorcycles	46.5	.8	22.6	20.3	.9	5.7	3.2
Quotient	1.3	.3	1.2	2.9	.6	.6	.1
Machine tools	53.4	.6	17.9	1.0	------	9.2	17.9
Quotient	1.5	.2	1.0	.1	------	1.0	.7
Perfumes and cosmetics	74.8	1.9	6.0	7.6	.2	1.8	7.7
Quotient	2.1	.7	.3	1.1	.1	.2	.3
Paper boxes [3]	55.2	4.6	13.3	7.8	.6	6.7	11.8
Quotient	1.6	1.6	.7	1.1	.4	.7	.5
Confectionery	65.4	5.0	4.7	9.3	(4)	3.7	11.9
Quotient	1.9	1.7	.3	1.3	(4)	.4	.5
Paints and varnishes	57.1	7.4	22.1	7.1	1.3	1.2	3.8
Quotient	1.6	2.6	1.2	1.0	.8	.1	.1
Fertilizer	18.3	.1	10.2	6.9	12.6	4.3	47.6
Quotient	.5	.03	.6	1.0	7.9	.5	1.8
Leather—Tanned, curried, and finished	22.9	10.2	24.8	6.1	.8	11.2	24.0
Quotient	.7	3.5	1.4	.9	.5	1.2	.9
Stamped and enameled ware	55.7	5.8	16.5	5.4	.9	5.0	10.7
Quotient	1.6	2.0	.9	.8	.6	.5	.4
Nonferrous metals, alloys, and products	56.4	2.3	20.0	2.0	6.6	6.6	6.1
Quotient	1.6	.8	1.1	.3	4.1	.7	.2
Gas and electric fixtures	66.8	2.1	13.8	4.8	2.9	4.3	5.3
Quotient	1.9	.7	.8	.7	1.8	.5	.2

TABLE 1.—*Percentage distribution of wage jobs and urbanization quotients [1] for designated types of areas in 50 industries, 1929* [2]—Continued

[First line for each industry, percentage of United States total; second line, ratio of industry percentage to percentage for all manufactures]

	A	B	C	D	E	F	G
Industry	Principal cities	Satellite cities	Industrial peripheries	Other cities over 100,000	Peripheries of D cities	Industrial counties	Smaller detached cities and rural areas
Printing and publishing book and job	65.5	3.6	6.5	9.8	0.1	4.0	10.5
Quotient	1.9	1.2	.4	1.4	.1	.4	.4
Printing and publishing newspaper and periodical	44.5	1.5	7.3	10.8	.7	6.0	29.2
Quotient	1.3	.5	.4	1.6	.4	.6	1.1
Hardware [3]	45.5	.9	31.7	5.3	.7	9.9	6.0
Quotient	1.3	.3	1.7	.8	.4	1.1	.2
Paper	5.5	.6	24.2	2.7	1.4	15.7	49.9
Quotient	.2	.2	1.3	.4	.9	1.7	1.9
Petroleum refining	8.7	7.5	27.8	1.1	9.2	18.6	27.1
Quotient	.2	2.6	1.5	.2	5.8	2.0	1.0
Chemicals [3]	17.0	4.4	45.8	1.7	2.4	.7	28.0
Quotient	.5	1.5	2.5	.2	1.5	.1	1.1
Cigars and cigarettes	25.9	2.5	10.8	24.3	.1	21.4	15.0
Quotient	.7	.9	.6	3.5	.1	2.3	.6
Planing mill products	26.9	1.3	10.0	9.4	1.3	10.2	40.9
Quotient	.8	.4	.5	1.4	.8	1.1	1.6
Flour and other grain products	24.5	.1	5.6	10.3	.8	3.6	55.1
Quotient	.7	.03	.3	1.5	.5	.4	2.1
Clay products (other than pottery)	9.3	.2	25.7	2.6	3.7	6.6	1.9
Quotient	.3	.1	1.4	.4	2.3	.7	2.0
Rayon and allied products	4.2	.1	21.1	1.2	12.4	20.6	40.4
Quotient	.1	.03	1.2	.2	7.8	2.2	1.6
Meat packing, wholesale	50.7	3.2	10.3	14.6	1.4	2.6	17.2
Quotient	1.4	1.1	.6	2.1	.9	.3	.7
Bread and other bakery products	50.2	3.6	8.6	12.1	.4	5.9	19.2
Quotient	1.4	1.2	.5	1.8	.3	.6	.7
Lumber and timber products	2.2	------	2.2	2.0	1.2	4.1	88.3
Quotient	.1	------	.1	.3	.8	.4	3.4

[1] Percentage in a particular industry divided by percentage in all manufactures.
[2] See Carter Goodrich and others, *Migration and Economic Opportunity*, University of Pennsylvania Press, Philadelphia, 1936, pp. 318-320 for classification of areas and pp. 708-734 for data on the percentage of wage jobs in each industry.
[3] Not elsewhere classified.
[4] Less than one-twentieth of 1 percent.

ing.[3] For men's and women's clothing the proportion of jobs in principal cities is approximately twice that for manufactures as a whole. Chemicals and steel works and rolling mills show high proportions of manufacturing employment in industrial peripheries, quotients of 2.5 and 2.8. On the other hand, jobs in the foundry and machine-shop products group are distributed among types of industrial areas approximately in accord with the pattern of manufacturing as a whole.

Relative Distribution by States

The extent to which an industry is concentrated in different areas has often been indicated on maps, by means of shading.[4] But in dealing with locational problems the analyst may require a quantitative meas-

[3] For each type of area, the upper limit of the measure is set by its proportion of the national total. Thus, for principal cities with 35.1 percent of all manufacturing wage earners in 1929, the measure cannot exceed 2.8, whereas for satellite cities with 2.9 percent the measure may reach 34.5.

[4] See, for example, Maryland State Planning Board, *Economic Studies*. These studies include such maps for the United States as a whole and not merely for Maryland.

ure, and not merely a qualitative indication, of local concentration. Since localization in a given industry may be considered to occur when a particular industry deviates from a common pattern, a measure may be obtained for a specific area by dividing the share of the national total for a given manufacturing industry in the area by its share of all manufacturing. This measure, which will be termed herein, the "location quotient," indicates only the relative location of the manufacturing segment of the economy. It has been calculated by States (on the basis of the *Census of Manufactures* for 1939), for 127 of the country's leading industries, as shown in table 2 [5]. The higher the location quotient in any instance, the greater the degree of localization of that particular industry as compared to all manufacturing. To cite one illustration from the table, Michigan has 63.87 percent of all workers in automobile factories, but it has only 6.62 percent of the nation's total manufacturing wage earners. The location quotient for automobile factories in Michigan is thus 9.65, an unusually high ratio.

Divergent location patterns are shown for different industries. It would be inadvisable to attempt to blueprint the same locational policy for each of them. It is obvious that coal mining must be centralized where the most accessible deposits of coal are situated; but almost equally urgent conditions may be determined in the localization of certain manufactures. Automobile factories, for example, show a very high degree of localization. The location quotients range from 9.65 in Michigan to zero in many States. Automobile factories have found survival value, probably allied closely to economies of large-scale production, in not being distributed parallel with the wage-earning population in manufacturing as a whole. A similar deviation, though to a lesser degree, is shown by blast furnaces and rolling mills, generating machinery, and lighting fixtures. On the other hand, sheet metal and nonferrous metals work is normally conducted in plants scattered throughout every major manufacturing region. The making of paper containers is even more decentralized.

Degree of Localization of Industries

The location quotient measures for a particular area the degree to which a given manufacturing industry is localized, as compared with manufacturing generally. To enable comparison of the locational structure of an industry for the entire country with the national structure of industry generally, a different measure is needed. The measure adopted here, called the "coefficient of localization," is the sum of the plus differences (or, since they total the same, the minus differences) between the State percentages of workers in the given manufacturing industry and the State percentages of workers in all manufacturing industries. The coefficient for each industry considered is given in the last column of table 2. It is clear that a coefficient of zero signifies complete coincidence of the distribution of the particular industry with that of manufacturing in general (i. e., no concentration), and that the more nearly the coefficient approaches one the greater is the differentiation.[6] Thus automobile factories show, in the percentage of workers, plus differences from all manufacture in three areas, Indiana, Michigan, and Wisconsin. The differences are 3.21, 57.25, and 1.05, respectively, a total of 61.51 percent, or a coefficient of 0.62.

The value of the coefficient depends to some extent on the areas into which a country is divided and on the location of the boundaries. Division of the country into smaller units would give a more detailed measurement and a higher figure; but unless an industry is irregularly distributed within the divisions chosen, as is rayon production or airplane assembling, further subdivision would make only a small difference in the magnitude of the coefficient.

An examination of the locational quotients and coefficients shown in the table will reveal how widely varied is the locational structure of American industries.

Many manufacturing industries have extremely low coefficients and resemble in this respect the residentiary service industries. It is clear that some production has to be located close to population centers, because of perishability (baking, for example) or because of need for close communication with the consumers (i. e., newspapers).

Geographic Association of Industries

The extent to which the distribution of an industry conforms to or deviates from the distribution of population is shown roughly by the coefficient of localization, since there is a somewhat close correspondence between the distribution of manufacturing and that of population.[7] The locational association of any particular industry with the final consuming market is the complement of the corresponding localization measure.

[5] A number of industries are unrepresented in certain States because of the nondisclosure rule of the *Census of Manufactures*; such cases are indicated in the table by the reference "a." Note also that States with a small proportion of manufacturing have been lumped together.

[6] The measure cannot reach one because that would require a given industry to be located in an area with zero percent of all industry.

[7] As shown in table 4, p. 120, only 23.41 percent of all employed workers in 1940 were in manufacturing. Nevertheless, as shown in table 3, p. 119, the association of total wage earners with total population is 0.78, which is high enough to validate the proposition here advanced.

TABLE 2.—*Distribution of wage earners among States or State groups, and coefficient of*

[First line for each industry, percentage of United States total; second

Industry (classified according to the Census for 1939)	United States, number of wage earners (thousands)	Maine	New Hampshire, Vermont	Massachusetts	Rhode Island	Connecticut	New York	New Jersey	Pennsylvania	Ohio	Indiana	Illinois	Michigan	Wisconsin	Missouri	Minnesota	Iowa
Total manufacturing	7,887.0	0.96	0.98	5.84	1.35	2.96	12.14	5.50	10.88	7.59	3.52	7.56	6.62	2.55	2.26	1.01	0.83
GROUP 1—FOODS																	
Flour, etc	24.8	.04	(a)	.14	(a)	(a)	7.56	.22	2.95	4.35	4.47	6.60	2.44	1.34	7.04	8.99	1.09
Location quotient	------	*.04*	(a)	*.02*	(a)	(a)	*.62*	*.04*	*.27*	*.57*	*1.27*	*.87*	*.37*	*.53*	*3.12*	*8.90*	*1.31*
Bread, etc	201.6	.58	.56	5.73	.84	1.71	15.58	4.81	10.80	7.29	2.48	7.51	4.57	2.22	3.03	1.74	1.49
Location quotient	------	*.60*	*.57*	*.98*	*.62*	*.58*	*1.28*	*.87*	*.99*	*.96*	*.70*	*.99*	*.69*	*.87*	*1.34*	*1.72*	*1.80*
Biscuits and crackers	29.2	(a)	(a)	5.62	------	(a)	15.74	3.77	11.39	8.54	2.89	12.53	4.05	1.98	4.87	1.45	3.01
Location quotient	------	(a)	(a)	*.96*	------	(a)	*1.30*	*.69*	*1.05*	*1.13*	*.82*	*1.66*	*.61*	*.78*	*2.15*	*1.44*	*3.39*
Prepared feeds, for animals	15.4	.12	1.91	2.07	(a)	.59	14.56	1.95	5.58	6.85	2.10	7.24	1.05	1.14	4.16	1.55	2.81
Location quotient	------	*.13*	*1.95*	*.35*	(a)	*.20*	*1.20*	*.35*	*.51*	*.90*	*.60*	*.96*	*.16*	*.45*	*1.84*	*1.53*	*3.93*
Pickled, canned, and dried fruits and vegetables	107.9	1.02	(a)	.33	------	.09	8.24	4.50	4.22	3.11	6.47	4.88	2.97	4.34	.77	2.09	1.14
Location quotient	------	*1.06*	(a)	.06	------	.03	.68	.82	.39	.41	1.84	.65	.45	1.70	.34	2.07	*1.34*
Malt liquors	36.1	------	(a)	2.09	.88	.88	12.18	3.74	10.30	7.81	4.57	6.97	5.12	9.88	10.33	4.58	.29
Location quotient	------	------	(a)	*.36*	*.65*	*.30*	*1.00*	*.68*	*.95*	*1.03*	*1.30*	*.92*	*.77*	*3.87*	*4.57*	*4.53*	*.35*
Non-alcoholic beverages	21.3	.50	.49	4.16	54	1.07	8.21	3.65	6.32	4.88	2.78	6.94	2.90	2.28	3.31	1.83	1.51
Location quotient	------	*.52*	*.50*	*.71*	*.40*	*.36*	*.68*	*.66*	*.58*	*.64*	*.79*	*.92*	*.44*	*.89*	*1.46*	*1.81*	*1.82*
Beet sugar	10.4	------	------	------	------	------	------	------	------	4.48	(a)	------	15.22	(a)	------	(a)	(a)
Location quotient	------	------	------	------	------	------	------	------	------	*.59*	(a)	------	*2.30*	(a)	------	(a)	(a)
Candy and confectionery	49.7	.04	(a)	11.65	.39	.91	12.60	3.81	12.09	3.33	1.55	24.25	1.79	1.63	3.53	1.09	.58
Location quotient	------	*.04*	(a)	*1.99*	*.29*	*.31*	*1.04*	*.56*	*1.11*	*.44*	*.44*	*3.21*	*.27*	*.64*	*1.56*	*1.08*	*.70*
Meat packing	119.9	.10	(a)	1.74	.03	.22	4.80	2.56	4.24	5.07	3.60	19.60	1.85	2.88	3.79	7.34	9.20
Location quotient	------	*.10*	(a)	*.30*	*.02*	*.07*	*.40*	*.47*	*.39*	*.67*	*1.02*	*2.59*	*.28*	*1.13*	*1.68*	*7.27*	*11.08*
Poultry, dressing	14.5	(a)	(a)	1.30	(a)	(a)	1.39	.50	2.40	1.12	1.62	4.08	.46	.63	7.78	10.41	19.12
Location quotient	------	(a)	(a)	*.22*	(a)	(a)	*.11*	*.09*	*.22*	*.15*	*.46*	*.54*	*.07*	*.25*	*3.44*	*10.31*	*23.04*
Creamery butter	18.0	(a)	.20	.07	------	------	.88	(a)	.77	6.22	5.15	4.36	4.83	8.87	4.77	13.31	9.48
Location quotient	------	(a)	*.20*	*.01*	------	------	*.07*	(a)	*.07*	*.82*	*1.46*	*.58*	*.73*	*3.48*	*2.11*	*13.18*	*11.42*
Canned fish	15.7	14.58	------	.17	(a)	------	.13	(a)	------	------	------	------	------	(a)	------	------	------
Location quotient	------	*15.19*	------	*.03*	(a)	------	*.01*	(a)	------	------	------	------	------	(a)	------	------	------
GROUP 2—TOBACCO MANUFACTURES																	
Cigars and cigarettes	78.3	.03	.64	.34	.04	.63	2.95	11.31	19.93	2.77	1.67	.38	2.00	.21	.45	.06	(a)
Location quotient	------	*.03*	*.65*	*.06*	*.03*	*.21*	*.24*	*2.06*	*1.83*	*.36*	*.47*	*.05*	*.30*	*.08*	*.20*	*.06*	(a)
GROUP 3—TEXTILE-MILL AND OTHER FIBER PRODUCTS																	
Cotton thread and yarn	83.8	.70	.19	9.15	4.18	2.80	1.37	2.18	.32	.01	.10	.65	.11	------	------	------	------
Location quotient	------	*.73*	*.19*	*1.57*	*3.10*	*.95*	*.11*	*.40*	*.03*	*.001*	*.05*	*.09*	*.02*	------	------	------	------
Cotton fabrics	325.6	2.80	2.28	9.29	3.45	2.00	1.34	.40	1.56	.03	.28	.22	.05	------	.04	------	------
Location quotient	------	*2.92*	*2.33*	*1.59*	*2.56*	*.68*	*.11*	*.07*	*.14*	*.004*	*.08*	*.03*	*.01*	------	*.02*	------	------
Cordage and twine	12.1	.06	------	12.53	.69	2.20	18.08	2.95	10.76	2.86	------	3.23	1.46	.25	1.76	------	------
Location quotient	------	*.06*	------	*2.15*	*.51*	*.74*	*1.49*	*.54*	*.99*	*.38*	------	*.43*	*.22*	*.10*	*.78*	------	------
Knitted cloth	10.9	------	------	11.38	1.34	.39	34.44	8.77	20.47	2.89	(a)	.71	.91	(a)	------	(a)	------
Location quotient	------	------	------	*1.95*	*.99*	*.13*	*2.84*	*1.59*	*1.88*	*.38*	(a)	*.09*	*.14*	(a)	------	(a)	------
Rayon throwing, spinning, yarn, and thread	8.4	------	------	2.49	5.88	------	6.33	9.67	55.24	------	------	------	------	------	------	------	------
Location quotient	------	------	------	*.43*	*4.36*	------	*.52*	*1.76*	*5.08*	------	------	------	------	------	------	------	------
Rayon fabrics	75.7	2.68	1.69	11.74	10.60	4.60	2.57	4.93	18.51	.10	------	.31	------	------	------	------	------
Location quotient	------	*2.79*	*1.72*	*2.01*	*7.85*	*1.55*	*.21*	*.90*	*1.70*	*.01*	------	*.04*	------	------	------	------	------
Hosiery—seamless	61.9	(a)	1.75	.93	------	(a)	1.65	(a)	10.43	.36	(a)	4.22	(a)	1.43	(a)	------	------
Location quotient	------	(a)	*1.08*	*.16*	------	(a)	*.14*	(a)	*.96*	*.05*	(a)	*.56*	(a)	*.56*	(a)	------	------
Silk throwing, spinning, yarn, and thread	21.6	------	------	4.90	3.54	3.15	11.21	5.20	55.91	------	.47	4.20	------	------	------	------	.21
Location quotient	------	------	------	*.84*	*2.62*	*1.06*	*.92*	*.95*	*5.14*	------	*.13*	*.56*	------	------	------	------	*.25*
Silk fabrics	14.2	------	------	3.92	1.96	11.08	7.37	22.66	42.63	------	------	------	------	------	------	------	------
Location quotient	------	------	------	*.67*	*1.45*	*3.74*	*.61*	*4.12*	*3.92*	------	------	------	------	------	------	------	------
Hosiery, full-fashioned	97.2	------	(a)	2.58	(a)	------	3.42	6.28	36.27	(a)	4.88	.69	.82	5.05	(a)	(a)	(a)
Location quotient	------	------	(a)	*.44*	(a)	------	*.28*	*1.14*	*3.33*	(a)	*1.39*	*.09*	*.12*	*1.98*	(a)	(a)	(a)
Woolen and worsted fabrics	146.1	6.01	5.87	31.09	16.09	4.42	4.89	7.66	8.77	2.11	.56	.71	.70	.65	(a)	.25	(a)
Location quotient	------	*6.26*	*5.99*	*5.32*	*11.92*	*1.49*	*.40*	*1.39*	*.81*	*.28*	*.16*	*.09*	*.11*	*.25*	(a)	*.25*	(a)
Dyeing and finishing	60.2	1.58	.51	15.49	12.87	4.92	8.41	20.40	7.14	.60	.18	.39	------	.02	.41	------	------
Location quotient	------	*1.65*	*.52*	*2.65*	*9.53*	*1.66*	*.69*	*3.71*	*.66*	*.08*	*.05*	*.05*	------	*.01*	*.18*	------	------

See footnotes at end of table.

localization for the United States, selected manufacturing industries, 1939

line, ratio of industry percentage to percentage for total manufacturing]

North Dakota, South Dakota, Nebraska, Kansas	District of Columbia, Delaware, Maryland	Virginia	West Virginia	North Carolina	South Carolina	Georgia	Florida	Kentucky	Tennessee	Alabama, Mississippi	Arkansas, Oklahoma	Louisiana	Texas	Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada	Washington	Oregon	California	Undistributed for indicated industry*	Corresponding undistributed portion for total manufacturing*	Coefficient of localization**
0.74	2.16	1.70	0.95	3.43	1.61	2.00	0.67	0.80	1.67	2.07	0.82	0.90	1.61	0.88	1.14	0.81	3.49	...		
13.38 18.08	[1] 1.01 .49	2.69 1.58	.66 .69	2.75 .80	.29 .18	1.27 .64	(a) (a)	3.24 4.05	3.64 2.18	.44 .21	3.65 4.45	.18 .20	6.54 4.06	[2] 4.80 5.62	3.43 3.01	2.25 2.78	2.04 .58	0.42 .07	6.07	0.48
2.01 2.72	3.00 1.39	1.05 .62	.86 .91	1.18 .34	.52 .32	1.05 .53	1.22 1.82	.88 1.10	1.20 .72	1.19 .57	1.35 1.65	1.26 1.40	2.80 1.74	1.96 2.28	1.23 1.08	.71 .88	5.59 1.60	... ...		.14
(a) (a)	2.29 1.06	.87 .51	... ...	(a) (a)	(a) (a)	(a) (a)	(a) (a)	(a) (a)	1.76 1.05	[3] 1.17 .79	[4] .63 1.37	1.67 1.86	2.07 1.29	(a) (a)	1.52 1.33	.55 .68	4.80 1.38	6.83 .44	15.55	.19
3.94 5.32	[1] 3.35 1.63	1.23 .72	.05 .05	1.17 .34	.75 .47	1.45 .73	.92 1.37	.59 .74	3.70 2.22	1.91 .92	2.54 3.10	1.69 1.88	4.17 2.59	[2] 4.17 4.79	2.74 2.40	1.81 2.23	10.04 2.88	.10 .07	1.46	.32
[5] .24 .71	8.03 3.72	2.27 1.34	.27 .28	.32 .09	.17 .11	1.24 .62	4.01 5.99	.34 .43	.77 .46	(a) (a)	1.00 1.22	.47 .52	2.13 1.32	[6] 2.53 3.51	3.43 3.01	3.88 4.79	24.02 6.88	.71 .20	3.61	.44
(a) (a)	[7] 3.00 1.67	.24 .14	(a) (a)	(a) (a)	... ...	(a) (a)	.57 .85	2.10 2.63	.40 .24	... ...	.18 .22	1.83 2.03	1.91 1.19	[5] 1.24 1.94	1.56 1.37	.22 .27	5.31 1.52	1.81 .23	8.00	.27
2.25 3.04	2.70 1.25	2.22 1.31	1.17 1.23	3.75 1.09	1.69 1.05	3.41 1.71	2.32 3.46	1.89 2.36	2.87 1.72	4.00 1.93	3.14 3.83	2.89 3.21	6.73 4.18	2.56 2.91	.47 .41	.44 .54	4.13 1.18	...		.25
(a) (a)	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	... ...	[21] 39.92 47.52	(a) (a)	(a) (a)	18.73 5.37	21.65 2.04	10.61	.74
[9] .27 .42	[10] 1.53 .81	1.70 1.00	.03 .03	1.29 .38	.18 .11	2.33 1.17	.16 .24	.58 .73	1.23 .74	.41 .20	.42 .51	1.01 1.12	1.51 .94	[11] 1.01 1.36	.95 .83	.35 .43	5.53 1.58	.27 .18	1.48	.28
12.22 16.51	[1] 1.83 .89	.79 .46	.24 .25	.18 .05	.27 .17	1.37 .69	.26 .39	.90 1.13	1.27 .76	.63 .30	1.79 2.18	.17 .19	3.29 2.04	[12] 2.14 2.55	1.04 .91	.54 .67	3.91 1.12	.14 .13	1.12	.45
15.92 21.51	5.59 2.59	.79 .46	... ...	... ...	... ...	... ...	(a) (a)	.43 .54	1.06 .63	(a) (a)	[13] 4.78 13.28	(a) (a)	9.82 6.10	[14] 1.70 2.36	1.05 .92	1.37 1.69	5.20 1.49	1.48 .14	10.51	.68
13.60 18.38	(a) (a)	.60 .35	.11 .12	.19 .06	.03 .02	.17 .09	... ...	1.34 1.68	1.13 .68	.63 .30	3.48 4.24	.11 .12	3.34 2.07	[15] 6.86 8.58	3.14 2.75	1.93 2.38	4.07 1.17	.36 .04	8.60	.59
... ...	.24 .11	.12 .07	... ...	.66 .19	3.35 2.08	5.01 2.52	.98 1.46	... ...	... ...	11.31 5.46	... ...	17.50 19.44	(a) (a)	... ...	5.08 4.46	3.84 4.74	35.32 10.12	1.68 .15	11.01	.83
... ...	.23 .11	8.60 5.06	.91 .96	19.63 5.72	(a) (a)	.16 .08	12.42 18.54	4.57 5.71	(a) (a)	... ...	... ...	1.55 1.72	(a) (a)	(a) (a)	...	(a) (a)	.90 .26	7.62 1.09	6.98	.55
... ...	.01 .004	... ...	... ...	46.93 13.68	5.13 3.19	15.70 7.85	... ...	.14 .18	3.76 2.25	6.53 3.15	... ...	... ...	... ...			... ...	.04 .01	... ...		.73
... ...	.38 .18	3.78 2.22	... ...	21.65 6.31	21.67 13.46	14.99 7.50	... ...	.24 .30	1.32 .79	9.51 4.59	.48 .59	.34 .38	1.79 1.11			.01 .01	.10 .03	... ...	...	.70
... ...	3.54 1.64	.26 .15	... ...	8.14 2.37	1.33 .83	9.19 4.60	... ...	3.72 4.65	2.02 1.21	7.41 3.58	.24 .29	2.30 2.56	2.33 .45		.45 .39	.51 .63	1.73 .50	... ...	...	.37
... ...	... ...	(a) (a)	... ...	3.58 1.04	(a) (a)	1.03 .52	... ...	... ...	8.80 5.27	... ...	... ...	... ...	... ...			... ...	(a) (a)	5.29 .38	13.88	.48
... ...	2.36 1.09	9.55 5.62	... ...	7.95 2.32	... ...	...	...	...	... ...	... ...	... ...	... ...	... ...		... ...	... ...	.53 .15	... ...		.66
... ...	.51 .24	4.37 2.57	... ...	18.50 5.39	15.58 9.68	1.83 .92	...	.01 .01	1.21 .72	.24 .12	... ...	... ...	... ...		... ...	... ...	.02 .01	... ...		.59
... ...	[10] .66 .35	3.88 2.28	(a) (a)	36.08 10.52	.94 .58	10.72 5.36	...	1.25 1.56	17.32 10.37	3.51 1.70	(a) (a)	(a) (a)	(a) (a)			...		5.87 .22	26.27	.61
... ...	... ...	1.03 .61	1.28 1.35	4.12 1.20	.69 .43	1.64 .82	... ...	... ...	2.33 1.40	.01 ...	... ...	... ...	...			...	.11 .03			.49
... ...	.45 .21	9.24 5.44	... ...	... ...	... ...	... ...	... ...	... ...	.48 .29	... ...	... ...	... ...	... ...	...	...	...	.21 .06			.65
... ...	1.55 .72	2.95 1.74	(a) (a)	20.93 6.10	.57 .35	2.07 1.04	.21 .31	.78 .98	4.90 2.93	1.84 .89	... ...	(a) (a)	.37 .23		...		.63 .18	3.21 .21	15.60	.52
... ...	[10] .40 .21	.99 .58	.65 .68	2.23 .65	(a) (a)	1.85 .93	... ...	(a) (a)	1.19 .71	... ...	... ...	(a) (a)	(a) (a)	(a) (a)	(a) (a)	.87 1.07	.28 .08	1.76 .18	9.60	.74
...	2.79 1.29	1.14 .67	.44 .46	5.67 1.65	9.86 6.12	2.27 1.14	... ...	.11 .18	2.77 1.66	1.76 .85	... ...	... ...	... ...	...	... ...	... ...	.24 .07			.51

TABLE 2.—*Distribution of wage earners among States or State groups, and coefficient of*

Industry (classified according to the Census for 1939)	United States, number of wage earners (thousands)	Maine	New Hampshire, Vermont	Massachusetts	Rhode Island	Connecticut	New York	New Jersey	Pennsylvania	Ohio	Indiana	Illinois	Michigan	Wisconsin	Missouri	Minnesota	Iowa
Total manufacturing	7,887.0	0.96	0.98	5.84	1.35	2.96	12.14	5.50	10.88	7.59	3.52	7.56	6.62	2.55	2.26	1.01	0.83
GROUP 4—APPAREL AND RELATED PRODUCTS																	
Women's outerwear (except wool)	162.2	(a)	(a)	5.05	.12	2.78	45.88	9.00	10.50	1.67	1.05	7.72	.97	.78	3.60	.62	.22
Location quotient	......	(a)	(a)	*.86*	*.09*	*.94*	*3.78*	*1.64*	*.97*	*.22*	*.30*	*1.02*	*.15*	*.31*	*1.59*	*.61*	*.27*
Children's dresses	15.1	......	......	2.48	......	(a)	29.43	16.95	42.28	(a)	......	.96	......	......	......	......	......
Location quotient	......	......	......	*.42*	......	(a)	*2.42*	*3.08*	*3.89*	(a)	......	*.12*	......	......	......	......	......
Women's and children's cotton underwear	11.3	......	......	19.40	......	8.74	18.66	16.75	21.32	.62	(a)	1.15	(a)	......	(a)	(a)	(a)
Location quotient	......	......	......	*3.32*	......	*2.95*	*1.54*	*3.05*	*1.96*	*.08*	(a)	*.15*	(a)	......	(a)	(a)	(a)
Knitted garments	61.1	(a)	[16] 1.27	4.57	(a)	.66	28.41	3.00	21.29	3.03	(a)	1.69	3.01	2.90	(a)	.30	......
Location quotient	......	......	*4.70*	*.78*	(a)	*.22*	*2.34*	*.55*	*1.96*	*.40*	(a)	*.22*	*.45*	*1.14*	(a)	*.30*	......
Corsets and allied garments	18.8	......	......	3.31	(a)	14.05	38.40	18.07	2.23	......	3.73	8.93	7.14	......	(a)	......	......
Location quotient	......	......	......	*.57*	(a)	*4.75*	*3.16*	*3.29*	*.20*	......	*1.06*	*1.18*	*1.08*	......	(a)	......	......
Men's and boys' shirts	70.5	(a)	(a)	4.55	(a)	5.11	13.99	7.78	28.62	2.27	2.47	.63	.04	(a)	5.43	(a)	(a)
Location quotient	......	(a)	(a)	*.78*	(a)	*1.73*	*1.15*	*1.41*	*2.63*	*.30*	*.70*	*.08*	*.01*	(a)	*2.40*	(a)	(a)
Work clothing	57.0	.46	.53	2.87	.06	.32	5.16	4.46	6.75	3.74	7.14	5.14	2.17	1.68	9.08	1.82	1.45
Location quotient	......	*.48*	*.54*	*.49*	*.04*	*.11*	*.43*	*.81*	*.62*	*.49*	*2.03*	*.68*	*.33*	*.66*	*4.02*	*1.80*	*1.75*
Women's and children's silk underwear	20.5	......	......	4.42	(a)	7.79	38.24	19.32	16.62	.20	.69	2.85	......	......	3.11	(a)	......
Location quotient	......	......	......	*.76*	(a)	*2.63*	*3.15*	*3.51*	*1.53*	*.03*	*.20*	*.38*	......	......	*1.38*	(a)	......
Men's neckwear	9.6	......	......	6.04	......	7.23	33.72	6.21	8.59	5.37	(a)	6.31	.92	(a)	5.86	.34	(a)
Location quotient	......	......	......	*1.03*	......	*2.44*	*2.78*	*1.13*	*.79*	*.71*	(a)	*.83*	*.14*	(a)	*2.59*	*.34*	(a)
Men's and boys' suits	137.5	(a)	(a)	4.35	(a)	.46	31.41	7.38	16.03	7.82	1.27	10.17	.10	.48	1.58	.33	.19
Location quotient	......	(a)	(a)	*.74*	(a)	*.16*	*2.59*	*1.34*	*1.47*	*1.03*	*.36*	*1.35*	*.02*	*.19*	*.70*	*.33*	*.23*
Trousers (semidress)	19.5	(a)	......	7.38	......	2.45	8.76	3.58	15.87	4.26	8.53	5.04	.20	(a)	6.87	.89	(a)
Location quotient	......	(a)	......	*1.26*	......	*.83*	*.72*	*.65*	*1.46*	*.56*	*2.42*	*.67*	*.03*	(a)	*3.04*	*.88*	(a)
Women's coats and suits	45.5	......	......	4.31	......	2.62	58.70	10.76	2.99	3.09	.69	4.91	.13	(a)	2.25	.36	......
Location quotient	......	......	......	*.74*	......	*.89*	*4.84*	*1.96*	*.27*	*.41*	*.20*	*.65*	*.02*	(a)	*1.00*	*.36*	......
Trimmings	9.3	......	......	6.15	......	(a)	67.30	2.23	2.64	1.58	(a)	5.73	3.51	(a)	2.01	(a)	(a)
Location quotient	......	......	......	*1.05*	......	(a)	*5.54*	*.41*	*.24*	*.21*	(a)	*.76*	*.53*	(a)	*.89*	(a)	(a)
Embroideries	8.5	......	......	1.50	......	(a)	44.17	36.09	4.75	1.28	......	5.77	(a)	(a)	1.60	(a)	......
Location quotient	......	......	......	*.26*	......	(a)	*3.64*	*6.56*	*.44*	*.17*	......	*.76*	(a)	(a)	*.71*	(a)	......
Curtains and draperies	16.9	......	......	12.92	1.12	(a)	19.05	4.05	4.54	.18	......	5.31	.13	(a)	2.20	(a)	......
Location quotient	......	......	......	*2.21*	*.83*	(a)	*1.57*	*.74*	*.42*	*.02*	......	*.70*	*.02*	(a)	*.97*	(a)	......
Textile Bags	12.0	(a)	......	.85	(a)	(a)	13.62	2.31	2.71	3.36	(a)	4.36	.41	1.25	10.49	3.14	......
Location quotient	......	(a)	......	*.15*	(a)	(a)	*1.12*	*.42*	*.25*	*.44*	(a)	*.58*	*.06*	*.49*	*4.64*	*3.11*	......
GROUPS 5 AND 6—FOREST PRODUCTS																	
Logging camps and logging contractors	22.8	5.14	.95	......	......	......	1.66	......	.44	(a)	(a)	......	3.94	3.18	.11	3.41	......
Location quotient	......	*5.35*	*.97*	......	......	......	*.04*	......	*.14*	(a)	(a)	......	*.60*	*1.25*	*.05*	*3.38*	......
Sawmills	265.2	1.15	1.16	.26	.01	04	.62	.13	.67	.32	.74	.31	1.68	1.92	.74	.45	.02
Location quotient	......	*1.20*	*1.18*	*.04*	*.01*	*.01*	*.05*	*.02*	*.06*	*.04*	*.21*	*.04*	*.25*	*.75*	*.33*	*.45*	*.02*
Planing mill products, not elsewhere classified	62.8	.57	.90	1.62	.25	.70	3.99	1.10	4.04	2.63	1.75	5.51	2.53	6.72	1.90	2.50	5.86
Location quotient	......	*.59*	*.92*	*.28*	*.19*	*.24*	*.33*	*.20*	*.37*	*.35*	*.50*	*.73*	*.38*	*2.64*	*.84*	*2.48*	*7.06*
Household furniture	94.8	.30	1.65	3.48	......	.37	7.06	1.22	7.33	3.49	10.42	9.24	6.61	3.19	.39	.31	.42
Location quotient	......	*.31*	*1.68*	*.60*	......	*.13*	*.58*	*.22*	*.67*	*.46*	*2.96*	*1.22*	*1.00*	*1.25*	*.17*	*.31*	*.51*
Office furniture	11.8	......	......	1.42	......	......	25.91	1.85	4.58	20.96	11.35	10.76	12.88	1.67	.76	.30	(a)
Location quotient	......	......	......	*.24*	......	......	*2.13*	*.34*	*.42*	*2.76*	*3.22*	*1.42*	*1.95*	*.65*	*.34*	*.30*	(a)
Wooden boxes (except cigar boxes)	25.4	2.22	[18] 3.70	4.17	.45	.87	2.81	2.68	2.20	3.01	1.89	5.52	2.14	5.51	1.29	.93	.26
Location quotient	......	*2.31*	*5.21*	*.71*	*.33*	*.29*	*.23*	*.49*	*.20*	*.40*	*.54*	*.73*	*.32*	*2.16*	*.57*	*.92*	*.31*
Wood products, n. e. c.	22.0	13.24	10.00	3.29	.29	.60	8.38	.85	6.77	5.27	3.51	4.52	7.73	2.31	2.30	1.53	.11
Location quotient	......	*13.79*	*10.20*	*.56*	*.21*	*.20*	*.69*	*.15*	*.62*	*.69*	*1.00*	*.60*	*1.17*	*.91*	*1.02*	*1.51*	*.13*
Wood preserving	11.2	(a)	(a)	(a)	......	(a)	1.46	1.34	.77	4.24	2.56	7.52	1.50	(a)	1.80	4.18	......
Location quotient	......	(a)	(a)	(a)	......	(a)	*.12*	*.24*	*.07*	*.56*	*.73*	*.99*	*.23*	(a)	*.80*	*4.14*	......

See footnotes at end of table.

localization for the United States, selected manufacturing industries, 1939—Continued

North Dakota, South Dakota, Nebraska, Kansas	District of Columbia, Delaware, Maryland	Virginia	West Virginia	North Carolina	South Carolina	Georgia	Florida	Kentucky	Tennessee	Alabama, Mississippi	Arkansas, Oklahoma	Louisiana	Texas	Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada	Washington	Oregon	California	Undistributed for indicated industry*	Corresponding undistributed portion for total manufacturing*	Coefficient of localization**
0.74	2.16	1.70	0.95	3.43	1.61	2.00	0.67	0.80	1.67	2.07	0.82	0.90	1.61	0.88	1.14	0.81	3.49	...		
(a) (a)	[1] 1.04 *.50*	.08 *.05*	.33 *.35*	(a) (a)	(a) (a)	.38 *.19*	.03 *.04*	(a) (a)	.24 *.14*	(a) (a)	.15 *.18*	(a) (a)	.95 *.59*	(a) (a)	.25 *.22*	.02 *.02*	3.97 *1.14*	2.60 *.23*	11.35	0.39
...	(a) (a)	.88 *.52*	...	...	...	...	...	...	(a) (a)	(a) (a)	(a) (a)	...	1.07 *.66*	...	...	...	1.14 *.33*	4.87 *.30*	16.12	.60
...	(a) (a)	(a) (a)	...	2.52 *.73*	(a) (a)	...	...	...	...	...	...	...	...	...	(a) (a)	...	.94 *.27*	9.90 *.52*	18.95	.48
...	(a) (a)	2.53 *1.49*	...	5.95 *1.73*	...	1.61 *.81*	...	...	6.40 *3.83*	[3] 2.59 *1.75*	...	...	...	.56 *.64*	.20 *.18*	.64 *.79*	2.19 *.63*	7.20 *.64*	11.19	.37
...	(a) (a)	...	...	...	...	(a) (a)	...	...	...	...	...	(a) (a)	(a) (a)	...	(a) (a)	...	2.94 *.84*	1.20 *.11*	11.16	.52
(a) (a)	8.77 *4.06*	1.61 *.95*	(a) (a)	1.58 *.46*	1.03 *.64*	2.13 *1.07*	(a) (a)	(a) (a)	2.00 *1.20*	4.56 *2.20*	(a) (a)	...	.15 *.09*	...	...	...	1.37 *.39*	5.91 *.53*	11.20	.37
(a) (a)	2.09 *.97*	5.82 *3.42*	.51 *.54*	4.20 *1.22*	(a) (a)	5.29 *2.65*	.35 *.52*	2.46 *3.08*	5.89 *3.53*	3.98 *1.92*	[4] 1.46 *3.17*	1.12 *1.24*	7.35 *4.57*	.74 *.84*	1.05 *.92*	.58 *.72*	3.81 *1.09*	.47 *.18*	2.61	.35
...	...	(a) (a)	...	(a) (a)	...	(a) (a)	...	...	...	...	...	...	.50 *.31*	(a) (a)	(a) (a)	...	2.86 *.82*	3.40 *.32*	10.78	.51
(a) (a)	3.46 *1.60*	...	(a) (a)	(a) (a)	...	.79 *.40*	...	(a) (a)	...	...	...	2.52 *2.80*	1.11 *.69*	(a) (a)	(a) (a)	(a) (a)	6.31 *1.81*	5.22 *.36*	14.31	.36
(a) (a)	[7] 8.04 *4.47*	1.65 *.97*	...	(a) (a)	...	.71 *.36*	...	1.83 *2.29*	1.76 *1.05*	(a) (a)	...	1.08 *1.20*	.15 *.09*	(a) (a)	.03 *.03*	.13 *.16*	1.65 *.47*	1.40 *.15*	9.57	.37
.25 *.34*	4.40 *2.04*	(a) (a)	(a) (a)	...	(a) (a)	10.43 *5.22*	(a) (a)	2.32 *2.90*	(a) (a)	(a) (a)	...	2.44 *2.71*	5.09 *3.16*	(a) (a)	.10 *.09*	...	3.04 *.87*	8.10 *.61*	13.31	.33
(a) (a)	1.86 *.86*	(a) (a)	...	...	...	...	.09 *.13*	...	...	...	...	...	.32 *.20*	...	.15 *.13*	.62 *.77*	5.80 *1.66*	.35 *.07*	4.89	.54
(a) (a)	.37 *.17*	(a) (a)	...	...	...	...	...	...	(a) (a)	...	(a) (a)	...	(a) (a)	...	(a) (a)	(a) (a)	1.62 *.46*	6.86 *.37*	18.40	.55
...	2.06 *.95*	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	1.03 *.30*	1.75 *.13*	13.14	.63
...	(a) (a)	...	...	1.99 *.58*	1.85 *1.15*	36.99 *18.50*	...	(a) (a)	2.68 *1.60*	(a) (a)	(a) (a)	...	.59 *.37*	(a) (a)	.50 *.44*	(a) (a)	3.33 *.95*	2.57 *.21*	12.07	.50
[20] 1.18 *2.36*	1.36 *.63*	4.70 *2.76*	...	5.35 *1.56*	(a) (a)	4.23 *2.12*	(a) (a)	(a) (a)	5.66 *3.39*	[3] 1.96 *1.32*	...	7.74 *8.60*	6.94 *4.31*	(a) (a)	(a) (a)	2.62 *3.23*	6.49 *1.86*	9.27 *.65*	14.29	.41
(a) (a)	(a) (a)	1.17 *.69*	.27 *.28*	1.22 *.36*	2.01 *1.25*	1.39 *.70*	4.18 *6.24*	.18 *.23*	(a) (a)	2.64 *1.28*	1.49 *1.82*	1.18 *1.31*	2.30 *1.43*	[21] 4.72 *5.62*	31.39 *27.54*	25.29 *31.22*	1.24 *.36*	.50 *.04*	13.15	.72
(a) (a)	.34 *.16*	3.73 *2.19*	1.89 *1.99*	4.54 *1.32*	3.65 *2.27*	3.62 *1.81*	4.90 *7.31*	1.15 *1.44*	1.95 *1.17*	12.42 *6.00*	6.88 *8.39*	6.39 *7.10*	5.47 *3.40*	[2] 4.21 *4.84*	11.36 *9.96*	10.93 *13.49*	6.17 *1.77*	.18 *.38*	48	.65
[22] 1.09 *1.54*	1.37 *.63*	3.66 *2.15*	.68 *.72*	5.55 *1.62*	1.42 *.88*	3.32 *1.66*	1.49 *2.22*	1.30 *1.63*	5.32 *3.19*	7.61 *3.68*	2.77 *3.38*	2.32 *2.58*	3.10 *1.93*	[21] 1.47 *1.75*	5.15 *4.52*	2.06 *2.54*	7.70 *2.21*	05 *.71*	07	.42
(a) (a)	.56 *.26*	8.43 *4.96*	(a) (a)	14.10 *4.11*	1.53 *.95*	1.84 *.92*	.40 *.60*	3.60 *4.50*	2.89 *1.73*	[3] .13 *.09*	[4] 1.83 *3.98*	1.07 *1.19*	.90 *.56*	(a) (a)	1.21 *1.06*	1.76 *2.17*	3.68 *1.05*	.59 *.19*	3.18	.34
(a) (a)	...	...	(a) (a)	4.30 *1.25*	...	...	(a) (a)	...	(a) (a)	(a) (a)	(a) (a)	...	(a) (a)	...	...	(a) (a)	1.07 *.31*	2.19 *.27*	7.99	.45
[23] .48 *.72*	2.07 *.96*	2.14 *1.26*	.47 *.49*	2.69 *.84*	2.84 *1.76*	8.57 *4.29*	9.35 *13.96*	1.41 *1.76*	3.12 *1.87*	5.97 *2.88*	[4] .92 *2.00*	2.10 *2.33*	4.02 *2.50*	[25] 1.02 *1.40*	3.19 *2.80*	2.31 *2.85*	6.79 *1.95*	.69 *.81*	.85	.41
(a) (a)	[10] .24 *.13*	.75 *.44*	1.22 *1.28*	2.56 *.75*	.19 *.12*	.75 *.38*	.08 *.12*	1.38 *1.73*	9.93 *5.95*	1.91 *.92*	[4] 4.46 *9.70*	.66 *.73*	.74 *.46*	...	.73 *.64*	.83 *1.02*	2.05 *.59*	.82 *.66*	1.26	.36
(a) (a)	(a) (a)	3.86 *2.27*	(a) (a)	1.78 *.52*	3.81 *2.37*	4.84 *2.42*	3.36 *5.01*	3.52 *4.40*	2.23 *1.34*	13.64 *6.59*	4.68 *5.71*	4.72 *5.24*	10.86 *6.75*	[26] 3.56 *7.74*	3.12 *2.74*	2.06 *2.54*	2.18 *.62*	6.41 *.38*	16.85	.51

TABLE 2.—*Distribution of wage earners among States or State groups, and coefficient of*

Industry (classified according to the Census for 1939)	United States, number of wage earners (thousands)	Maine	New Hampshire, Vermont	Massachusetts	Rhode Island	Connecticut	New York	New Jersey	Pennsylvania	Ohio	Indiana	Illinois	Michigan	Wisconsin	Missouri	Minnesota	Iowa
Total manufacturing	7,887.0	0.96	0.98	5.84	1.35	2.96	12.14	5.50	10.88	7.59	3.52	7.56	6.62	2.55	2.26	1.01	0.83
GROUPS 7 AND 8—PAPER AND PRINTING																	
Pulp mills	26.9	11.34	4.48	(a)	------	------	6.25	------	4.73	(a)	------	------	3.36	10.56	(a)	3.66	------
Location quotient	------	*11.81*	*4.57*	(a)	------	------	*.51*	------	*.43*	(a)	------	------	*.51*	*4.14*	(a)	*3.62*	------
Paper and paperboard mills	110.6	7.03	2.72	8.96	(a)	1.59	11.48	4.04	7.69	8.08	1.66	3.31	10.77	10.02	(a)	1.78	(a)
Location quotient	------	*7.32*	*2.78*	*1.53*	(a)	*.54*	*.95*	*.73*	*.71*	*1.06*	*.47*	*.44*	*1.63*	*3.93*	(a)	*1.76*	(a)
Converted paper products	21.8	(a)	(a)	16.93	(a)	2.57	19.25	4.73	10.76	5.06	3.76	6.48	8.94	5.93	4.35	.52	(a)
Location quotient	------	(a)	(a)	*2.81*	(a)	*.87*	*1.59*	*.86*	*.99*	*.67*	*1.07*	*.86*	*1.35*	*2.33*	*1.92*	*.51*	(a)
Paper containers, not elsewhere classified	62.5	.21	[18] .18	8.20	.72	3.20	20.08	7.11	9.92	8.11	3.87	9.77	4.71	2.72	4.26	.58	.43
Location quotient	------	*.22*	*.25*	*1.40*	*.53*	*1.08*	*1.65*	*1.29*	*.91*	*1.07*	*1.10*	*1.29*	*.71*	*1.07*	*1.88*	*.57*	*.52*
Newspapers	97.0	.59	.66	5.20	.55	1.63	14.43	2.83	8.58	5.78	3.07	7.82	3.62	3.28	3.27	2.51	2.25
Location quotient	------	*.61*	*.67*	*.89*	*.41*	*.55*	*1.19*	*.51*	*.79*	*.76*	*.87*	*1.03*	*.55*	*.93*	*1.45*	*2.49*	*2.71*
Bookbinding	25.7	.09	.28	10.75	.06	.12	34.95	7.08	5.67	5.58	2.66	12.18	4.04	2.00	1.93	.80	.55
Location quotient	------	*.09*	*.29*	*1.84*	*.04*	*.04*	*2.88*	*1.29*	*.52*	*.74*	*.76*	*1.61*	*.61*	*.78*	*.85*	*.79*	*.66*
Lithographing	26.0	------	(a)	4.23	(a)	.73	26.30	2.82	6.12	10.20	.61	18.72	2.19	2.58	3.14	4.40	.31
Location quotient	------	------	(a)	*.72*	(a)	*.25*	*2.17*	*.51*	*.56*	*1.34*	*.17*	*2.48*	*.33*	*1.01*	*1.39*	*4.36*	*.37*
GROUPS 9 AND 10—CHEMICALS AND RELATED PRODUCTS																	
Fertilizers	18.7	.87	(a)	1.03	(a)	.68	1.42	3.79	2.76	4.97	1.57	2.64	1.71	.74	------	(a)	------
Location quotient	------	*.91*	(a)	*.18*	(a)	*.23*	*.12*	*.69*	*.25*	*.65*	*.45*	*.35*	*.26*	*.29*	------	(a)	------
Cottonseed oil, cake, etc	15.2	------	------	------	------	------	------	------	------	------	------	1.29	------	------	(a)	------	------
Location quotient	------	------	------	------	------	------	------	------	------	------	------	*.17*	------	------	(a)	------	------
Drugs and medicines	22.4	(a)	.18	3.32	.07	2.21	20.20	11.58	9.40	3.45	8.19	7.58	10.93	.57	6.76	1.40	1.40
Location quotient	------	(a)	*.18*	*.57*	*.05*	*.75*	*1.66*	*2.11*	*.86*	*.45*	*2.33*	*1.00*	*1.65*	*.22*	*2.99*	*1.39*	*1.69*
Perfumes and cosmetics	10.4	------	------	.54	(a)	3.34	44.61	16.24	1.95	6.76	.90	8.39	.66	.58	4.49	1.08	1.61
Location quotient	------	------	------	*.09*	(a)	*1.13*	*3.67*	*2.95*	*.18*	*.89*	*26*	*1.11*	*.10*	*.23*	*1.99*	*1.07*	*1.94*
Soap and glycerin	13.6	------	------	10.80	.18	(a)	11.32	18.20	5.29	12.41	9.21	10.86	.15	.25	2.22	.26	1.07
Location quotient	------	------	------	*1.85*	*.13*	(a)	*.93*	*3.31*	*.49*	*1.64*	*2.62*	*1.44*	*.02*	*.10*	*.98*	*.26*	*1.29*
Paints, varnishes, lacquers	22.3	(a)	(a)	2.98	.55	.96	11.63	14.64	8.88	11.71	2.19	15.37	8.19	2.58	3.83	1.12	.16
Location quotient	------	(a)	(a)	*.51*	*.41*	*.32*	*.96*	*2.66*	*.82*	*1.54*	*.62*	*2.03*	*1.24*	*1.01*	*1.69*	*1.11*	*.19*
Chemicals, not elsewhere classified	60.3	(a)	(a)	.87	.22	.94	15.53	19.57	6.03	8.31	2.31	4.27	8.91	.19	2.01	.07	.54
Location quotient	------	(a)	(a)	*.15*	*.16*	*.32*	*1.28*	*3.56*	*.55*	*1.09*	*.66*	*.56*	*1.35*	*.07*	*.89*	*.07*	*.65*
Petroleum refining	72.8	------	------	.82	(a)	------	2.09	8.40	11.25	3.23	8.76	5.88	.93	------	(a)	(a)	------
Location quotient	------	------	------	*.14*	(a)	------	*.17*	*1.53*	*1.03*	*.43*	*2.49*	*.78*	*.14*	------	(a)	(a)	------
GROUPS 11 AND 12—RUBBER AND LEATHER																	
Rubber products	50.7	.16	(a)	14.49	6.57	4.76	8.84	19.15	4.92	13.94	6.12	4.44	3.03	1.24	1.58	(a)	.73
Location quotient	------	*.17*	(a)	*2.48*	*4.87*	*1.61*	*.73*	*3.48*	*.45*	*1.84*	*1.74*	*.59*	*.46*	*.49*	*.70*	(a)	*.88*
Leather, tanned and curried	47.3	1.23	[18] 1.36	19.79	(a)	.37	9.92	6.30	17.21	3.31	.70	9.06	4.97	9.41	.36	(a)	------
Location quotient	------	*1.28*	*1.92*	*3.39*	(a)	*.13*	*.82*	*1.15*	*1.58*	*.44*	*.20*	*1.20*	*.75*	*3.69*	*.16*	(a)	------
Boot and shoe cut stock	18.8	3.35	9.42	38.98	.77	(a)	8.87	.70	7.31	3.35	(a)	4.80	(a)	1.29	18.07	------	------
Location quotient	------	*3.49*	*9.61*	*6.67*	*.57*	(a)	*.73*	*.13*	*67*	*.44*	(a)	*.63*	(a)	*.51*	*8.00*	------	------
Footwear	218.0	7.11	[18] 8.50	20.91	(a)	.39	14.32	1.16	6.76	6.95	.84	7.99	.46	4.48	12.35	.33	.10
Location quotient	------	*7.41*	*11.97*	*3.58*	(a)	*.13*	*1.18*	*.21*	*.62*	*.92*	*.24*	*1.06*	*.07*	*1.76*	*5.46*	*.33*	*.12*
Leather goods	38.4	(a)	(a)	7.57	(a)	3.78	41.16	12.02	8.17	1.18	.30	6.53	.78	6.44	2.46	(a)	.46
Location quotient	------	(a)	(a)	*1.30*	(a)	*1.28*	*3.39*	*2.19*	*.75*	*.16*	*.09*	*.86*	*.12*	*2.53*	*1.09*	(a)	*.55*
GROUP 13—STONE, CLAY, AND GLASS PRODUCTS																	
Brick and hollow tile	29.1	.42	[18] .43	.89	(a)	1.44	6.96	2.96	8.35	13.89	3.79	6.70	1.60	.54	1.66	.68	2.93
Location quotient	------	*.44*	*.61*	*.15*	(a)	*.49*	*.57*	*54*	*.77*	*1.83*	*1.08*	*.89*	*.24*	*.21*	*.73*	*.67*	*3.53*
Clay refractories	12.2	------	------	(a)	------	(a)	(a)	2.85	30.23	14.97	.84	2.30	(a)	(a)	18.98	------	------
Location quotient	------	------	------	(a)	------	(a)	(a)	*.52*	*2.78*	*1.97*	*.24*	*.30*	(a)	(a)	*8.40*	------	------
Concrete products	17.4	.49	(a)	4.60	.52	1.36	7.63	6.01	8.35	5.64	3.67	4.31	5.76	2.63	2.71	3.30	1.93
Location quotient	------	*.51*	(a)	*.79*	*.39*	*.46*	*.63*	*1.09*	*.77*	*.74*	*1.04*	*.57*	*.87*	*1.03*	*1.20*	*3.27*	*2.33*
Mirrors and other glass products	10.0	------	------	2.16	(a)	2.90	22.94	8.12	8.76	17.92	2.88	12.76	2.91	.47	1.57	.18	(a)
Location quotient	------	------	------	*.37*	(a)	*.98*	*1.89*	*1.48*	*.81*	*2.36*	*.82*	*1.69*	*.44*	*.18*	*.69*	*.18*	(a)
Glass tableware and containers	53.1		------	(a)	(a)	------	9.03	8.75	20.22	19.81	11.22	7.32	------	------	------	------	------
Location quotient	------		------	(a)	(a)	------	*.74*	*1.59*	*1.86*	*2.61*	*3.19*	*.97*	------	------	------	------	------

See footnotes at end of table.

localization for the United States, selected manufacturing industries, 1939—Continued

North Dakota, South Dakota, Nebraska, Kansas	District of Columbia, Delaware, Maryland	Virginia	West Virginia	North Carolina	South Carolina	Georgia	Florida	Kentucky	Tennessee	Alabama, Mississippi	Arkansas, Oklahoma	Louisiana	Texas	Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada	Washington	Oregon	California	Undistributed for indicated industry*	Corresponding undistributed portion for total manufacturing*	Coefficient of localization**
0.74	2.16	1.70	0.95	3.43	1.61	2.00	0.67	0.80	1.67	2.07	0.82	0.90	1.61	0.88	1.14	0.81	3.49	...	...	...
... ...	(a) (a)	7.03 *4.14*	... ...	4.01 *1.17*	2.13 *1.32*	(a) (a)	4.26 *6.36*	... ...	2.78 *1.66*	[3] 1.87 *1.26*	(a) (a)	6.65 *7.39*	(a) (a)	... ...	14.33 *12.57*	3.48 *4.30*	(a) (a)	9.08 *.35*	25.64 ...	0.58 ...
(a) (a)	[1] 1.10 *.94*	2.30 *1.35*	.63 *.66*	.99 *.29*	.84 *.52*	.52 *.26*	.85 *1.27*	... ...	(a) (a)	[3] 1.02 *.69*	(a) (a)	2.92 *2.54*	(a) (a)	... ...	2.84 *2.49*	1.58 *1.95*	1.96 *.56*	3.11 *.34*	9.27 ...	.28 ...
(a) (a)	(a) (a)	.57 *.34*	... ...	(a) (a)	(a) (a)	1.57 *.79*	... ...	(a) (a)	.76 *.46*	... ...	... ...	(a) (a)	.36 *.22*	... ...	2.15 *1.89*	(a) (a)	1.59 *.46*	4.26 *.31*	13.81 ...	.27 ...
[23] 1.10 *1.64*	[7] 1.87 *1.04*	1.16 *.68*	.98 *1.03*	1.36 *.40*	.06 *.04*	.83 *.42*	.15 *.22*	.36 *.45*	1.19 *.71*	(a) (a)	.38 *.46*	1.00 *1.11*	.65 *.40*	[25] .19 *.26*	.82 *.72*	.21 *.26*	3.05 *.87*	.57 *.24*	2.33 ...	.18 ...
3.36 *4.54*	2.79 *1.29*	1.12 *.66*	.86 *.91*	1.22 *.36*	.50 *.31*	1.21 *.61*	1.44 *2.15*	.97 *1.21*	1.37 *.82*	1.16 *.56*	1.96 *2.39*	.97 *1.08*	3.58 *2.22*	3.08 *3.50*	1.51 *1.32*	1.03 *1.27*	6.70 *1.92*	... ...	... ...	.20 ...
(a) (a)	[10] 2.39 *1.26*	.53 *.31*	... ...	.38 *.11*	(a) (a)	.19 *.10*	.07 *.10*	.07 *.09*	2.59 *1.55*	[3] .11 *.07*	.14 *.17*	.13 *.14*	.62 *.39*	[15] .23 *.29*	.14 *.12*	.18 *.22*	2.97 *.85*	.52 *.16*	3.25 ...	.35 ...
(a) (a)	[10] 3.13 *1.65*	.90 *.53*	.24 *.25*	.32 *.09*	(a) (a)	.55 *.28*	... ...	1.08 *1.35*	.28 *.17*	(a) (a)	.12 *.15*	.12 *.13*	1.25 *.78*	[19] .44 *.58*	.66 *.58*	(a) (a)	6.40 *1.83*	2.16 *.30*	7.28 ...	.37 ...
(a) (a)	10.99 *5.09*	9.97 *5.86*	(a) (a)	10.26 *2.99*	8.35 *5.19*	12.17 *6.09*	7.23 *10.79*	.72 *.90*	3.16 *1.89*	7.99 *3.86*	[4] .64 *1.39*	2.80 *3.11*	1.02 *.63*	(a) (a)	.10 *.09*	.04 *.05*	1.06 *.30*	1.32 *.26*	5.11 ...	.57 ...
... ...	... ...	... ...	... ...	4.88 *1.42*	5.37 *3.34*	11.73 *5.87*	(a) (a)	... ...	6.72 *4.02*	22.10 *10.68*	13.74 *16.76*	4.82 *5.36*	25.13 *15.61*	1.55 *1.76*	... ...	... ...	2.31 *.66*	.36 *.12*	2.93 ...	.81 ...
1.61 *2.18*	[10] 1.94 *1.02*	.28 *.16*	.21 *.22*	1.11 *.32*	.03 *.02*	.34 *.17*	.10 *.15*	.29 *.36*	2.90 *1.74*	(a) (a)	[4] .13 *.28*	.28 *.31*	.65 *.40*	(a) (a)	.12 *.11*	.04 *.05*	2.17 *.62*	.56 *.14*	4.10 ...	.31 ...
(a) (a)	.11 *.05*	.37 *.22*	... ...	(a) (a)	... ...	.94 *.47*	(a) (a)	(a) (a)	1.52 *.91*	[3] .13 *.09*	(a) (a)	.30 *.33*	.91 *.57*	(a) (a)	.31 *.27*	(a) (a)	3.40 *.97*	.85 *.09*	9.16 ...	.48 ...
[20] 6.14 *12.28*	(a) (a)	... ...	... ...	... ...	... ...	.16 *.08*	... ...	... ...	.15 *.09*	.04 *.02*	... ...	(a) (a)	.15 *.09*	(a) (a)	.25 *.22*	(a) (a)	6.24 *1.79*	4.65 *.66*	7.02 ...	.40 ...
(a) (a)	[10] 1.27 *.67*	.32 *.19*	.05 *.05*	.22 *.06*	.14 *.09*	.40 *.20*	.13 *.19*	2.17 *2.71*	.91 *.54*	[3] .22 *.15*	.08 *.10*	.74 *.82*	.86 *.53*	(a) (a)	.32 *.28*	.34 *.42*	6.50 *1.86*	.53 *.15*	3.48 ...	.29 ...
.55 *.74*	[7] 1.69 *.94*	4.03 *2.37*	7.52 *7.92*	(a) (a)	.16 *.10*	.09 *.05*	.18 *.27*	(a) (a)	3.53 *2.11*	1.24 *.60*	[13] .17 *.47*	2.10 *2.33*	1.17 *.73*	(a) (a)	.21 *.18*	... ...	4.95 *1.42*	2.64 *.36*	7.33 ...	.34 ...
4.17 *5.64*	[10] 1.07 *.56*	(a) (a)	.54 *.57*	... ...	(a) (a)	(a) (a)	... ...	.78 *.98*	(a) (a)	(a) (a)	6.71 *8.18*	3.61 *4.01*	25.99 *16.14*	[11] 2.60 *3.51*	(a) (a)	(a) (a)	11.82 *3.39*	1.35 *.09*	15.43 ...	.55 ...
(a) (a)	2.27 *1.05*	.96 *.56*	(a) (a)	(a) (a)	(a) (a)	(a) (a)	... ...	(a) (a)	.06 *.04*	... ...	[13] .11 *.31*	... ...	.18 *.11*	(a) (a)	.06 *.05*	(a) (a)	2.49 *.71*	3.90 *.33*	11.88 ...	.38 ...
... ...	[27] 5.39 *14.97*	.94 *.55*	1.90 *2.00*	1.98 *.58*	... ...	(a) (a)	... ...	.62 *.78*	.80 *.48*	... ...	... ...	... ...	(a) (a)	(a) (a)	(a) (a)	.04 *.05*	1.45 *.42*	2.89 *.30*	9.48 ...	.36 ...
(a) (a)	(a) (a)	(a) (a)	... ...	(a) (a)	... ...	... ...	... ...	(a) (a)	(a) (a)	... ...	... ...	... ...	... ...	... ...	... ...	... ...	.29 *.08*	2.80 *.12*	23.00 ...	.60
(a) (a)	1.24 *.57*	1.41 *.83*	(a) (a)	(a) (a)	... ...	.70 *.35*	(a) (a)	.73 *.91*	2.18 *1.31*	(a) (a)	... ...	... ...	.10 *.06*	(a) (a)	.04 *.04*	.03 *.04*	.42 *.12*	.50 *.06*	8.87 ...	.44
... ...	[1] .27 *.13*	(a) (a)	... ...	... ...	... ...	... ...	(a) (a)	(a) (a)	... ...	... ...	... ...	(a) (a)	.10 *.06*	[15] .60 *.75*	.31 *.27*	.06 *.07*	1.53 *.44*	6.28 *.73*	8.55	.42
[9] 1.40 *2.19*	[1] 2.32 *1.13*	4.07 *2.39*	1.78 *1.87*	4.92 *1.43*	2.76 *1.71*	3.39 *1.70*	.55 *.82*	1.46 *1.83*	3.01 *1.80*	4.43 *2.14*	2.40 *2.93*	1.36 *1.51*	4.93 *3.06*	[2] 3.54 *4.07*	.82 *.72*	.37 *.46*	2.23 *.64*	1.02 *.56*	1.83 ...	.29
... ...	3.15 *1.46*	... ...	2.54 *2.67*	... ...	(a) (a)	3.58 *1.79*	... ...	11.62 *14.53*	... ...	1.92 *.93*	... ...	... ...	(a) (a)	[28] 1.80 *2.47*	(a) (a)	... ...	2.60 *.74*	2.62 *.08*	34.62 ...	.60
[22] 2.06 *2.90*	4.80 *2.22*	2.87 *1.69*	1.36 *1.43*	1.31 *.38*	.94 *.58*	1.66 *.83*	3.79 *5.66*	.98 *1.23*	1.95 *1.17*	1.85 *.89*	[13] 1.19 *3.31*	1.31 *1.46*	3.38 *2.10*	[29] 1.67 *2.11*	2.26 *1.98*	.62 *.77*	6.33 *1.81*	.76 *.49*	1.56	.22
(a) (a)	[1] 1.74 *.84*	2.73 *1.61*	1.49 *1.57*	2.97 *.87*	... ...	(a) (a)	.14 *.21*	.58 *.73*	1.02 *.61*	(a) (a)	(a) (a)	(a) (a)	.69 *.43*	(a) (a)	.31 *.27*	.27 *.33*	3.01 *.86*	1.48 *.19*	7.81 ...	.31 ...
... ...	2.37 *1.10*	... ...	13.79 *14.52*	... ...	(a) (a)	... ...	(a) (a)	... ...	(a) (a)	(a) (a)	[13] 1.72 *4.78*	... ...	(a) (a)	... ...	(a) (a)	... ...	3.30 *.95*	2.47 *.17*	14.99	.47

TABLE 2.—*Distribution of wage earners among States or State groups, and coefficient of*

Industry (classified according to the Census for 1939)	United States, number of wage earners (thousands)	Maine	New Hampshire, Vermont	Massachusetts	Rhode Island	Connecticut	New York	New Jersey	Pennsylvania	Ohio	Indiana	Illinois	Michigan	Wisconsin	Missouri	Minnesota	Iowa
Total manufacturing	7,887.0	0.96	0.98	5.84	1.35	2.96	12.14	5.50	10.88	7.59	3.52	7.56	6.62	2.55	2.26	1.01	0.83
GROUP 14—IRON AND STEEL																	
Blast furnace products	19.5	-----	-----	(a)	-----	-----	6.56	-----	29.00	24.24	8.22	7.70	4.45	-----	-----	(a)	-----
Location quotient	-----	-----	-----	(a)	-----	-----	*.54*	-----	*2.67*	*3.19*	*2.34*	*1.02*	*.67*	-----	-----	(a)	-----
Steel works and rolling mills	368.9	-----	-----	.53	(a)	(a)	4.43	1.88	36.45	19.49	9.85	6.80	2.67	(a)	(a)	(a)	-----
Location quotient	-----	-----	-----	*.09*	(a)	(a)	*.36*	*.34*	*3.35*	*2.57*	*2.80*	*.90*	*.40*	(a)	(a)	(a)	-----
Gray-iron, semi-steel castings	58.4	.18	.91	4.08	.47	2.75	6.13	4.80	8.28	18.31	8.41	8.78	12.93	3.32	2.61	1.15	1.22
Location quotient		*.19*	*.93*	*.70*	*.35*	*.93*	*.50*	*.87*	*.76*	*2.41*	*2.39*	*1.16*	*1.95*	*1.30*	*1.15*	*1.14*	*1.47*
Malleable iron castings	18.0	-----	(a)	(a)	(a)	3.36	7.75	4.05	9.19	14.22	10.95	17.88	16.40	7.25	(a)	(a)	(a)
Location quotient		-----	(a)	(a)	(a)	*1.14*	*.64*	*.74*	*.84*	*1.87*	*3.11*	*2.37*	*2.48*	*2.84*	(a)	(a)	(a)
Steel castings	30.1	-----	-----	.89	-----	(a)	4.49	1.03	24.30	15.04	6.70	17.95	4.74	8.36	3.27	(a)	(a)
Location quotient		-----	-----	*.15*	-----	(a)	*.37*	*.19*	*2.23*	*1.98*	*1.90*	*2.37*	*.72*	*3.28*	*1.45*	(a)	(a)
Forgings, iron and steel	15.4		-----	7.03	-----	3.32	6.62	3.14	12.77	20.02	6.84	17.04	10.00	8.51	(a)	-----	(a)
Location quotient				*1.20*	-----	*1.12*	*.55*	*.57*	*1.17*	*2.64*	*1.94*	*2.25*	*1.51*	*3.34*	(a)	-----	(a)
Fabricated structural steel	35.5	(a)	(a)	2.05	22	.56	9.29	3.60	22.56	10.25	4.05	5.64	4.25	2.26	2.07	1.98	1.11
Location quotient		(a)	(a)	*.35*	*.16*	*.19*	*.77*	*.65*	*2.07*	*1.35*	*1.15*	*.75*	*.64*	*.89*	*.92*	*1.96*	*1.34*
Stamped and pressed metal	33.1	(a)	-----	4.22	1.58	7.05	15.68	6.25	5.29	18.37	3.98	10.82	3.52	3.48	3.12	.62	.72
Location quotient	-----	(a)	-----	*.72*	*1.17*	*2.38*	*1.29*	*1.14*	*.49*	*2.42*	*1.13*	*1.43*	*.53*	*1.36*	*1.38*	*.61*	*.87*
Tin cans and other tinware	31.8	(a)	(a)	1.30	(a)	(a)	11.21	9.92	7.64	4.99	1.34	23.33	.79	.85	2.11	.98	-----
Location quotient		(a)	(a)	*22*	(a)	(a)	*.92*	*1.80*	*.70*	*.66*	*.38*	*3.09*	*.12*	*.33*	*.93*	*.97*	-----
Wire drawn from purchased rods	22.0	(a)	-----	16.18	(a)	6.46	11.07	11.83	13.87	6.61	7.24	12.17	8.20	(a)	(a)	-----	(a)
Location quotient		(a)	-----	*2.77*	(a)	*2.18*	*.91*	*2.15*	*1.27*	*.87*	*2.06*	*1.61*	*1.24*	(a)	(a)	-----	(a)
Power boilers	18.9	(a)	(a)	1.95	(a)	1.13	4.93	2.50	21.05	16.05	1.21	6.79	2.11	3.46	6.36	1.57	1.19
Location quotient		(a)	(a)	*.33*	(a)	*.38*	*.41*	*.45*	*1.93*	*2.11*	*.34*	*.90*	*.32*	*1.36*	*2.81*	*1.55*	*1.43*
Steam fittings	21.8	-----	-----	8.29	.60	5.94	3.45	1.55	11.25	11.28	.91	40.40	.54	3.41	1.16	(a)	(a)
Location quotient		-----	-----	*1.42*	*.44*	*2.01*	*.28*	*.28*	*1.03*	*1.49*	*.26*	*5.34*	*.08*	*1.34*	*.51*	(a)	(a)
Stoves, ranges, and water heaters	41.7	(a)	(a)	4.77	(a)	.84	4.17	.75	7.16	16.85	2.63	12.96	10.81	4.44	3.96	1.09	1.28
Location quotient	-----	(a)	(a)	*.82*	(a)	*.28*	*.34*	*.14*	*.66*	*2.22*	*.75*	*1.71*	*1.63*	*1.74*	*1.75*	*1.08*	*1.54*
Screw machine products	16.9	-----	(a)	7.93	6.16	15.15	5.47	1.28	6.13	19.75	2.26	17.83	12.74	1.56	.89	.21	-----
Location quotient	-----	-----	(a)	*1.36*	*4.56*	*5.12*	*.45*	*.23*	*.56*	*2.60*	*.64*	*2.36*	*1.92*	*.61*	*.39*	*.21*	-----
Bolts, nuts, washers, etc	14.3		-----	7.77	2.92	1.37	2.76	3.83	16.13	35.08	3.52	11.69	6.31	1.65	(a)	1.03	-----
Location quotient			-----	*1.33*	*2.16*	*.46*	*.23*	*.70*	*1.48*	*4.62*	*1.00*	*1.55*	*.95*	*.65*	(a)	*1.02*	-----
Tools (exc. edged tools)	15.3	(a)	1.56	9.51	.26	14.66	13.68	5.17	8.56	12.47	1.47	12.11	6.49	1.58	1.46	1.51	1.25
Location quotient		(a)	*1.59*	*1.63*	*.19*	*4.95*	*1.13*	*.94*	*.79*	*1.64*	*.42*	*1.60*	*.98*	*.62*	*.65*	*1.50*	*1.51*
Cutlery and edged tools	15.4	.73	[15] 1.65	15.26	5.24	21.07	21.11	9.79	3.88	5.86	.64	2.83	.73	1.51	4.62	(a)	(a)
Location quotient		*.76*	*2.32*	*2.61*	*3.88*	*7.12*	*1.74*	*1.78*	*.36*	*.77*	*.18*	*.37*	*.11*	*.59*	*2.04*	(a)	(a)
Hardware, not elsewhere classified	35.6	.96	(a)	3.04	.35	34.12	6.99	1.72	7.50	7.00	1.66	15.90	12.33	1.38	1.30	.30	1.41
Location quotient	-----	*1.00*	(a)	*.52*	*.26*	*11.53*	*.58*	*.31*	*.69*	*.92*	*.47*	*2.10*	*1.86*	*.54*	*.58*	*.30*	*1.70*
GROUP 15—NONFERROUS METALS																	
Sheet metal work, not elsewhere classified	18.7	(a)	(a)	3.78	.40	.90	8.34	6.79	7.79	11.74	3.27	10.93	4.04	6.97	3.63	2.94	2.41
Location quotient	-----	(a)	(a)	*.65*	*.30*	*.30*	*.69*	*1.23*	*.72*	*1.55*	*.93*	*1.45*	*.61*	*2.73*	*1.61*	*2.91*	*2.90*
Alloying (except aluminum)	38.8	-----	-----	1.75	2.53	42.67	12.66	6.77	4.68	3.99	1.66	5.71	7.78	2.69	.41	(a)	-----
Location quotient	-----	-----	-----	*.30*	*1.87*	*14.42*	*1.04*	*1.23*	*.43*	*.53*	*.47*	*.76*	*1.18*	*1.05*	*.18*	(a)	-----
Lighting fixtures	20.5	-----	-----	2.87	(a)	5.60	21.44	5.77	5.97	13.45	14.05	19.18	3.80	1.30	2.38	.05	.17
Location quotient		-----	-----	*.49*	(a)	*1.89*	*1.77*	*1.05*	*.55*	*1.77*	*3.99*	*2.54*	*.57*	*.51*	*1.05*	*.05*	*.20*
Clocks, watches, etc	17.9	-----	-----	15.43	(a)	36.68	7.51	1.91	7.37	1.02	(a)	27.13	(a)	(a)	-----	-----	-----
Location quotient		-----	-----	*2.64*	(a)	*12.39*	*.62*	*.35*	*.68*	*.13*	(a)	*3.59*	(a)	(a)	-----	-----	-----
Jewelry	11.4	(a)	-----	16.20	21.94	(a)	22.88	13.48	2.71	2.24	2.71	5.14	.86	.38	1.38	2.00	.17
Location quotient		(a)	-----	*2.77*	*16.25*	(a)	*1.88*	*2.45*	*.25*	*.30*	*.77*	*.68*	*.13*	*.15*	*.61*	*1.98*	*.20*
Nonferrous metal foundries	9.7	(a)	[18] .23	3.74	.39	3.96	10.73	3.50	11.06	16.89	1.60	12.74	6.00	4.27	4.85	.84	11.11
Location quotient		(a)	*.32*	*.64*	*.29*	*1.34*	*.88*	*.64*	*1.02*	*2.23*	*.45*	*1.69*	*.91*	*1.67*	*2.15*	*.83*	*1.34*
GROUPS 16 AND 17—ELECTRICAL EQUIPMENT; MACHINERY																	
Generating, distributing, and industrial appliances	70.4	-----	(a)	11.66	(a)	1.78	17.30	5.12	20.14	11.51	5.66	4.14	3.87	6.07	8.48	.49	.43
Location quotient	-----	-----	(a)	*2.00*	(a)	*60*	*1.43*	*.93*	*1.85*	*1.52*	*1.61*	*.55*	*.58*	*2.38*	*3.75*	*.49*	*.52*

See footnotes at end of table.

localization for the United States, selected manufacturing industries, 1939—Continued

North Dakota, South Dakota, Nebraska, Kansas	District of Columbia, Delaware, Maryland	Virginia	West Virginia	North Carolina	South Carolina	Georgia	Florida	Kentucky	Tennessee	Alabama, Mississippi	Arkansas, Oklahoma	Louisiana	Texas	Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada	Washington	Oregon	California	Undistributed for indicated industry*	Corresponding undistributed portion for total manufacturing*	Coefficient of localization**
0.74	2.16	1.70	0.95	3.43	1.61	2.00	0.67	0.80	1.67	2.07	0.82	0.90	1.61	0.88	1.14	0.81	3.49		...	
...	(a) (a)	(a) (a)	(a) (a)	...	...	...	...	(a) (a)	(a) (a)	11.38 *5.50*	...	...	...	(a) (a)			...	8.45 *.59*	14.22	0.49
...	[10] 4.50 *2.37*	(a) (a)	3.52 *3.71*	...	...	(a) (a)	...	1.35 *1.69*	(a) (a)	3.66 *1.77*	(a) (a)	...	(a) (a)	(a) (a)	(a) (a)	...	1.36 *.39*	3.51 *.18*	19.17	.51
[9] .52 *.81*	[10] .90 *.47*	1.05 *.62*	.24 *.25*	.52 *.15*	.25 *.16*	1.00 *.50*	.17 *.25*	.56 *.70*	1.15 *.69*	[3] .78 *.53*	(a) (a)	.32 *.36*	1.28 *.80*	[10] 1.15 *1.62*	.69 *.61*	.28 *.35*	4.12 *1.18*	.60 *.36*	1.94	.26
...	(a) (a)	...	(a) (a)	...	(a) (a)	...	...	...	...	...	...	...	(a) (a)	(a) (a)	...	...	(a) (a)	8.95 *.44*	20.22	.29
(a) (a)	(a) (a)	...	(a) (a)	...	...	(a) (a)	(a) (a)	...	(a) (a)	(a) (a)	(a) (a)	(a) (a)	(a) (a)	(a) (a)	(a) (a)	.98 *1.21*	3.97 *1.14*	8.28 *.48*	17.15	.42
...	.92 *.43*	(a) (a)	...	...	...	...	...	(a) (a)	(a) (a)	(a) (a)	...	...	(a) (a)	(a) (a)	.42 *.37*	(a) (a)	1.64 *.47*	1.73 *.15*	11.46	.38
[9] 2.39 *3.73*	[10] 1.90 *1.00*	2.09 *1.23*	1.12 *1.18*	.82 *.24*	(a) (a)	.46 *.23*	.25 *.37*	.85 *1.06*	2.00 *1.20*	[3] 2.77 *1.87*	[13] 1.77 *4.92*	.62 *.69*	3.86 *2.40*	[31] .89 *1.31*	.12 *.11*	.38 *.47*	6.51 *1.87*	1.31 *.25*	5.16	.27
(a) (a)	8.21 *3.80*	(a) (a)	3.14 *3.31*	(a) (a)	(a) (a)	...	(a) (a)	(a) (a)	...	(a) (a)	...	...	.34 *.21*	(a) (a)	.04 *.04*	(a) (a)	2.93 *.84*	.64 *.05*	12.75	.33
(a) (a)	12.35 *5.72*	(a) (a)	2.98 *3.14*	...	(a) (a)	(a) (a)	.49 *.73*	(a) (a)	.32 *.19*	...	(a) (a)	1.96 *2.18*	3.15 *1.96*	(a) (a)	1.18 *1.04*	(a) (a)	8.54 *2.45*	4.57 *.33*	13.91	.40
...	(a) (a)	...	...	...	...	...	...	...	...	...	...	...	(a) (a)	...	...	...	1.26 *.36*	5.11 *.45*	11.36	.33
1.08 *1.46*	[10] .75 *.39*	.92 *.54*	.28 *.29*	(a) (a)	...	1.68 *.84*	.45 *.67*	.33 *.41*	4.37 *2.62*	[3] 2.22 *1.50*	[13] 3.20 *8.89*	.59 *.66*	3.46 *2.15*	(a) (a)	.98 *.86*	.51 *.63*	6.50 *1.86*	2.38 *.30*	7.96	.35
...	(a) (a)	(a) (a)	...	...	...	...	...	...	(a) (a)	...	...	...	...	...	...	(a) (a)	1.67 *.48*	9.55 *1.22*	7.82	.45
[29] 1.16 *2.32*	.85 *.39*	.40 *.24*	.66 *.69*	(a) (a)	...	1.96 *.98*	.12 *.18*	1.13 *1.41*	9.61 *5.75*	3.32 *1.60*	(a) (a)	...	.18 *.11*	(a) (a)	.55 *.48*	.63 *.78*	6.98 *2.00*	.74 *.09*	7.81	.37
...	(a) (a)	...	...	...	...	...	...	...	...	...	...	...	(a) (a)	...	(a) (a)	...	2.07 *.59*	.57 *.11*	5.26	.48
...	(a) (a)	...	...	...	...	...	...	...	...	(a) (a)	...	...	(a) (a)	...	(a) (a)	(a) (a)	.75 *.21*	5.19 *.57*	9.10	.40
(a) (a)	(a) (a)	...	4.79 *5.04*	(a) (a)	...	...	(a) (a)	...	(a) (a)	(a) (a)	(a) (a)	...	.13 *.08*	(a) (a)	.09 *.08*	(a) (a)	1.40 *.40*	1.85 *.16*	11.65	.32
...	(a) (a)	...	(a) (a)	(a) (a)	...	...	...	(a) (a)	(a) (a)	...	(a) (a)	...	...	(a) (a)	(a) (a)	...	.16 *.05*	4.92 *.38*	13.04	.48
(a) (a)	(a) (a)	(a) (a)	(a) (a)	(a) (a)	...	...	...	.48 *.60*	(a) (a)	...	...	...	...	(a) (a)	(a) (a)	(a) (a)	1.84 *.55*	1.72 *.13*	13.15	.46
1.79 *2.42*	[7] 2.04 *1.13*	.67 *.39*	1.04 *1.09*	.19 *.06*	.15 *.09*	1.07 *.54*	.44 *.66*	.63 *.79*	.24 *.14*	[3] .38 *.26*	.73 *.89*	.99 *1.10*	1.77 *1.10*	[32] 1.60 *2.03*	1.31 *1.15*	1.94 *2.40*	8.49 *2.43*	.60 *.20*	2.98	.27
(a) (a)	2.62 *1.21*	(a) (a)	(a) (a)	...	...	(a) (a)	...	...	...	(a) (a)	...	...	(a) (a)	(a) (a)	(a) (a)	(a) (a)	.78 *.22*	3.30 *.29*	11.52	.44
...	.09 *.04*	...	...	...	...	...	...	(a) (a)	...	(a) (a)	(a) (a)	(a) (a)	(a) (a)	(a) (a)	(a) (a)	(a) (a)	3.23 *.93*	.65 *.07*	8.91	.40
...	...	...	...	...	...	...	...	...	...	...	(a) (a)	...	...	...	...	...	(a) (a)	2.95 *.16*	17.89	.63
(a) (a)	.53 *.25*	...	...	...	...	(a) (a)	(a) (a)	(a) (a)	...	...	(a) (a)	.44 *.49*	.79 *.49*	[30] .55 *.77*	.36 *.32*	.28 *.35*	3.47 *.99*	1.19 *.17*	8.63	.51
(a) (a)	[1] 1.41 *.74*	...	.49 *.52*	(a) (a)	(a) (a)	.52 *.26*	(a) (a)	.60 *.75*	.95 *.57*	(a) (a)	[13] .32 *.89*	(a) (a)	2.05 *1.27*	[33] 1.23 *1.68*	.76 *.67*	.41 *.51*	7.03 *2.01*	2.32 *.21*	10.83	.27
(a) (a)	1.26 *.13*	...	(a) (a)	(a) (a)	...	(a) (a)	...	.26 *.33*	...	(a) (a)	.05 *.06*	(a) (a)	.09 *.06*	(a) (a)	.11 *.10*	.07 *.09*	2.11 *.60*	.40 *.04*	11.25	.36

TABLE 2.—*Distribution of wage earners among States or State groups, and coefficient of*

Industry (classified according to the Census for 1939)	United States, number of wage earners (thousands)	Maine	New Hampshire, Vermont	Massachusetts	Rhode Island	Connecticut	New York	New Jersey	Pennsylvania	Ohio	Indiana	Illinois	Michigan	Wisconsin	Missouri	Minnesota	Iowa
Total manufacturing	7,887.0	0.96	0.98	5.84	1.35	2.96	12.14	5.50	10.88	7.59	3.52	7.56	6.62	2.55	2.26	1.01	0.83
GROUPS 16 AND 17—ELECTRICAL EQUIPMENT; MACHINERY—Continued.																	
Refrigerators	35.2	-------	(a)	.12	-------	(a)	4.99	1.66	11.44	27.96	17.23	2.32	19.40	1.27	2.11	4.96	(a)
Location quotient	-------	-------	(a)	*.02*	-------	(a)	*.41*	*.30*	*1.05*	*3.68*	*4.89*	*.31*	*2.93*	*.50*	*.93*	*4.91*	(a)
Radios, tubes, phonographs	43.5	-------	-------	6.49	(a)	1.60	11.20	27.13	9.09	4.45	6.65	23.80	2.02	-------	(a)	.25	(a)
Location quotient	-------	-------	-------	*1.11*	(a)	*.54*	*.92*	*4.93*	*.84*	*.59*	*1.89*	*3.15*	*.31*	-------	(a)	*.25*	(a)
Batteries, storage and primary	15.0	-------	-------	.50	(a)	4.58	6.22	10.96	17.61	22.15	7.49	5.39	.25	8.89	.84	1.81	3.31
Location quotient	-------	-------	-------	*.09*	(a)	*1.55*	*.51*	*1.99*	*1.62*	*2.92*	*2.13*	*.71*	*.04*	*3.49*	*.37*	*1.79*	*3.99*
Wiring devices and supplies	14.6	-------	(a)	5.25	(a)	20.10	24.39	4.58	11.60	5.33	2.17	14.80	(a)	(a)	2.06	(a)	(a)
Location quotient	-------	-------	(a)	*.90*	(a)	*6.79*	*2.01*	*.83*	*1.07*	*.70*	*.62*	*1.96*	(a)	(a)	*.91*	(a)	(a)
Automotive electric equipment	17.5	-------	(a)	5.84	(a)	(a)	9.32	1.54	10.46	27.89	35.70	2.23	4.72	1.18	.54	(a)	-------
Location quotient	-------	-------	(a)	*1.00*	(a)	(a)	*.77*	*.28*	*.96*	*3.67*	*10.14*	*.29*	*.71*	*.46*	*.24*	(a)	-------
Electric lamps, electric appliances, and other products, not elsewhere classified	35.5	-------	-------	9.20	1.20	9.62	6.29	18.04	2.13	27.03	.49	14.68	2.74	2.11	2.42	.04	.03
Location quotient	-------	-------	-------	*1.58*	*.89*	*3.25*	*.52*	*3.28*	*.20*	*3.56*	*.14*	*1.94*	*.41*	*.83*	*1.07*	*.04*	*.04*
Metal working machinery	15.9	-------	(a)	2.23	(a)	6.91	12.21	9.10	8.36	29.83	.80	12.29	5.53	1.06	.73	1.69	(a)
Location quotient	-------	-------	(a)	*.38*	(a)	*2.33*	*1.01*	*1.65*	*.77*	*3.93*	*.23*	*1.63*	*.84*	*.42*	*.32*	*1.67*	(a)
Mechanical power transmission equipment	30.3	-------	(a)	3.81	(a)	28.70	7.19	5.30	10.55	18.52	11.61	5.59	4.50	1.89	.72	(a)	(a)
Location quotient	-------	-------	(a)	*.65*	(a)	*9.70*	*.59*	*.96*	*.97*	*2.44*	*3.30*	*.74*	*.68*	*.74*	*.32*	(a)	(a)
Construction machinery	17.3	(a)	(a)	(a)	-------	-------	3.10	2.35	4.79	26.27	4.57	12.39	8.03	22.88	(a)	3.43	3.84
Location quotient	-------	(a)	(a)	(a)	-------	-------	*.26*	*.43*	*.44*	*3.46*	*1.30*	*1.64*	*1.21*	*8.97*	(a)	*3.40*	*4.63*
Machine shop products	60.7	.24	.10	4.78	1.33	2.07	7.97	3.49	14.84	12.09	5.69	9.35	14.80	3.06	2.14	.72	1.27
Location quotient	-------	*.25*	*.10*	*.82*	*.99*	*.70*	*.66*	*.63*	*1.36*	*1.59*	*1.62*	*1.24*	*2.24*	*1.20*	*.95*	*.71*	*1.53*
Machine tools	36.6	-------	[16] 4.70	9.74	8.90	12.37	5.48	1.34	3.85	29.51	2.40	7.09	7.24	6.02	(a)	(a)	(a)
Location quotient	-------	-------	*17.41*	*1.67*	*6.59*	*4.18*	*.45*	*.24*	*.35*	*3.89*	*.68*	*.94*	*1.09*	*2.36*	(a)	(a)	(a)
Machine tool accessories	25.2	-------	(a)	12.87	2.24	7.79	5.76	2.98	5.69	17.26	3.12	11.12	25.94	2.40	.53	.33	.26
Location quotient	-------	-------	(a)	*2.20*	*1.66*	*2.63*	*.47*	*.54*	*.52*	*2.27*	*.89*	*1.47*	*3.92*	*.94*	*.23*	*.33*	*.31*
Agricultural machinery (excluding tractors)	27.8	(a)	(a)	.44	-------	(a)	7.00	.14	2.01	5.41	12.73	47.72	2.20	7.98	.42	2.34	2.84
Location quotient	-------	(a)	(a)	*.08*	-------	(a)	*.58*	*.03*	*.18*	*.71*	*3.62*	*6.31*	*.33*	*3.13*	*.19*	*2.32*	*3.42*
Food-products machinery	14.0	-------	(a)	2.72	-------	1.25	18.66	2.07	4.38	15.01	2.66	16.49	4.63	10.61	1.79	3.00	1.66
Location quotient	-------	-------	(a)	*.47*	-------	*.42*	*1.54*	*.38*	*.40*	*1.98*	*.76*	*2.18*	*.70*	*4.16*	*.79*	*2.97*	*2.00*
Textile machinery	21.9	10.32	[18] 4.84	37.75	7.78	1.48	1.52	2.72	24.95	(a)	-------	1.97	(a)	-------	-------	-------	-------
Location quotient	-------	*10.75*	*6.82*	*6.46*	*5.76*	*.50*	*.13*	*.49*	*2.29*	(a)	-------	*.26*	(a)	-------	-------	-------	-------
Oil-field machinery	12.5	-------	-------	-------	-------	-------	-------	-------	8.35	6.84	(a)	.68	(a)	-------	.67	-------	-------
Location quotient	-------	-------	-------	-------	-------	-------	-------	-------	*.77*	*.90*	(a)	*.09*	(a)	-------	*.30*	-------	-------
Pumping equipment	19.2	-------	(a)	2.96	-------	1.14	10.77	12.97	7.88	13.38	4.88	11.34	5.95	3.14	2.33	3.15	7.43
Location quotient	-------	-------	(a)	*.51*	-------	*.39*	*.89*	*2.36*	*.72*	*1.76*	*1.39*	*1.50*	*.90*	*1.23*	*1.03*	*3.12*	*8.95*
Internal-combustion machinery	14.8	-------	-------	-------	-------	1.82	11.15	(a)	7.59	13.90	(a)	5.09	9.70	35.06	5.22	1.63	(a)
Location quotient	-------	-------	-------	-------	-------	*.61*	*.92*	(a)	*.70*	*1.83*	(a)	*.67*	*1.47*	*13.75*	*2.31*	*1.61*	(a)
Industrial machinery	21.9	(a)	(a)	6.63	.30	.83	12.40	15.45	12.42	10.33	2.43	8.27	5.72	2.13	1.07	1.28	.64
Location quotient	-------	(a)	(a)	*1.14*	*.22*	*.28*	*1.02*	*2.81*	*1.14*	*1.36*	*.69*	*1.09*	*.86*	*.84*	*.47*	*1.27*	*.77*
Office and store machinery	36.2	-------	-------	.93	(a)	30.47	29.68	2.31	.33	16.89	(a)	4.75	11.68	.32	.28	(a)	(a)
Location quotient	-------	-------	-------	*.16*	(a)	*10.29*	*2.44*	*.42*	*.03*	*2.23*	(a)	*.63*	*1.76*	*.13*	*.12*	(a)	(a)
GROUP 18—AUTOMOBILES AND EQUIPMENT																	
Motor vehicles and bodies	397.5	(a)	(a)	.31	.04	.22	4.04	2.26	3.42	7.51	6.73	1.85	63.87	3.60	1.76	.29	.03
Location quotient	-------	(a)	(a)	*.05*	*.03*	*.07*	*.33*	*.41*	*.31*	*.99*	*1.91*	*.24*	*9.65*	*1.41*	*.78*	*.29*	*.04*
GROUP 19—TRANSPORTATION EQUIPMENT (EXCEPT AUTOMOBILES)																	
Car and car equipment	24.5	-------	-------	(a)	-------	-------	7.36	1.13	19.24	3.61	10.24	22.61	(a)	1.27	7.62	.89	.22
Location quotient	-------	-------	-------	(a)	-------	-------	*.61*	*.21*	*1.77*	*.48*	*2.91*	*2.99*	(a)	*.50*	*3.37*	*.88*	*.27*
Aircraft parts	48.6	-------	-------	(a)	-------	11.10	12.87	9.45	2.60	1.55	(a)	.15	1.98	-------	.90	-------	-------
Location quotient	-------	-------	-------	(a)	-------	*3.75*	*1.06*	*1.72*	*.24*	*.20*	(a)	*.02*	*.30*	-------	*.40*	-------	-------
Shipbuilding and repairing	66.6	3.57	-------	10.85	.12	3.37	10.92	18.46	9.83	1.01	.17	.32	.53	.60	(a)	.12	(a)
Location quotient	-------	*3.72*	-------	*1.86*	*.09*	*1.14*	*.90*	*3.36*	*.90*	*.13*	*.05*	*.04*	*.08*	*.24*	(a)	*.12*	(a)

See footnotes at end of table.

localization for the United States, selected manufacturing industries, 1939—Continued

North Dakota, South Dakota, Nebraska, Kansas	District of Columbia, Delaware, Maryland	Virginia	West Virginia	North Carolina	South Carolina	Georgia	Florida	Kentucky	Tennessee	Alabama, Mississippi	Arkansas, Oklahoma	Louisiana	Texas	Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada	Washington	Oregon	California	Undistributed for indicated industry*	Corresponding undistributed portion for total manufacturing*	Coefficient of localization**
0.74	2.16	1.70	0.95	3.43	1.61	2.00	0.67	0.80	1.67	2.07	0.82	0.90	1.61	0.88	1.14	0.81	3.49	....	-	--
(a) (a)	[10] .31 *.16*	....	(a) (a)	.07 *.02*	....	.77 *.39*	....	(a) (a)	1.16 *.69*	....	(a) (a)	(a) (a)	.86 *.53*	(a) (a)	.10 *.09*	.10 *.12*	1.99 *.57*	1.18 *.14*	8.31	0.51
(a) (a)	(a) (a)	....	....	....	....	....	(a) (a)	(a) (a)	....	....	....	....	(a) (a)	....	.03 *.03*	(a) (a)	1.42 *.41*	5.87 *.55*	10.77	.42
(a) (a)	(a) (a)	(a) (a)	(a) (a)	(a) (a)	....	(a) (a)	.16 *.24*	.52 *.65*	.64 *.38*	.16 *.08*	(a) (a)	(a) (a)	2.43 *1.51*	(a) (a)	.22 *.19*	.11 *.14*	3.63 *1.04*	2.13 *.15*	14.06	.43
....	(a) (a)	....	1.70 *1.79*	....	....	(a) (a)	....	(a) (a)	(a) (a)	(a) (a)	....	....	....	(a) (a)	....	....	.84 *.24*	7.18 *.34*	21.12	.38
(a) (a)	....	....	....	....	....	....	....	....	....	....	....	....	(a) (a)	....	....	....	(a) (a)	.58 *.05*	10.93	.52
(a) (a)	[1] .37 *.18*	(a) (a)	(a) (a)	(a) (a)	....	(a) (a)	....	(a) (a)	.08 *.05*	(a) (a)	....	....	(a) (a)	(a) (a)	.09 *.08*	.04 *.05*	1.70 *.49*	1.70 *.13*	12.76	.49
....	(a) (a)	....	....	....	....	....	....	(a) (a)	....	....	....	....	....	....	(a) (a)	(a) (a)	2.03 *.58*	7.23 *.94*	7.71	.35
....	(a) (a)	(a) (a)	....	(a) (a)	....	....	....	(a) (a)	(a) (a)	....	(a) (a)	....	(a) (a)	(a) (a)	(a) (a)	....	.64 *.18*	.98 *.06*	16.71	.45
(a) (a)	(a) (a)	....	....	....	(a) (a)	(a) (a)	....	....	.79 *.47*	....	(a) (a)	....	.34 *.21*	(a) (a)	1.82 *1.60*	.84 *1.04*	2.67 *.77*	1.89 *.12*	16.18	.52
[13] .27 *.40*	[7] 2.07 *1.15*	.24 *.14*	.49 *.52*	.57 *.17*	.18 *.11*	.80 *.40*	.16 *.24*	1.47 *1.84*	.58 *.35*	.80 *.39*	.35 *.43*	.50 *.56*	1.11 *.69*	[2] .56 *.64*	.56 *.49*	.67 *.83*	4.38 *1.26*	.30 *.68*	.44	.23
....	(a) (a)	....	....	....	....	....	....	(a) (a)	....	....	....	....	....	....	....	....	(a) (a)	1.36 *.12*	10.90	.51
....	(a) (a)	....	....	....	....	....	....	.05 *.06*	(a) (a)	....	....	(a) (a)	(a) (a)	(a) (a)	.04 *.04*	(a) (a)	.79 *.23*	.83 *.10*	8.33	.45
[12] .77 *1.08*	....	1.09 *.64*	....	1.12 *.33*	....	1.30 *.65*	.03 *.04*	1.47 *1.84*	1.12 *.67*	(a) (a)	....	(a) (a)	.32 *.20*	(a) (a)	.19 *.17*	(a) (a)	1.04 *.30*	.32 *.03*	9.19	.59
(a) (a)	5.23 *2.42*	.23 *.14*	....	(a) (a)	....	(a) (a)	(a) (a)	.24 *.30*	(a) (a)	(a) (a)	(a) (a)	.83 *.92*	.24 *.15*	(a) (a)	.35 *.31*	.56 *.69*	4.21 *1.21*	3.18 *.28*	11.53	.38
....	(a) (a)	....	....	1.68 *.49*	2.17 *1.35*	.92 *.46*	....	(a) (a)	.11 *.07*	....	....	....	....	....	....	....	....	1.79 *.10*	17.08	.66
4.02 *5.43*	....	....	2.37 *2.49*	....	....	....	....	(a) (a)	(a) (a)	....	9.70 *11.83*	.89 *.99*	47.93 *29.77*	....	....	....	17.26 *4.95*	1.29 *.10*	12.61	.74
(a) (a)	....	....	....	(a) (a)	(a) (a)	.25 *.13*	(a) (a)	(a) (a)	(a) (a)	....	1.42 *1.73*	....	1.22 *.76*	(a) (a)	(a) (a)	(a) (a)	7.18 *2.06*	2.61 *.23*	11.21	.32
(a) (a)	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2.58 *.74*	6.26 *.62*	10.09	.45
(a) (a)	[10] 1.91 *1.01*	.69 *.41*	.05 *.05*	(a) (a)	(a) (a)	.72 *.36*	(a) (a)	.43 *.54*	.07 *.04*	(a) (a)	.17 *.21*	(a) (a)	.70 *.43*	[15] 2.66 *3.64*	1.57 *1.38*	.48 *.59*	5.08 *1.46*	5.57 *.54*	10.37	.20
....	(a) (a)	(a) (a)	....	....	....	....	(a) (a)	....	....	....	....	....	....	....	(a) (a)	....	1.76 *.50*	.60 *.05*	12.02	.59
(a) (a)	[1] .44 *.21*	.28 *.16*	(a) (a)	.09 *.03*	(a) (a)	.42 *.21*	.01 *.01*	.31 *.39*	.26 *.16*	(a) (a)	(a) (a)	.05 *.06*	.33 *.20*	(a) (a)	.09 *.08*	.05 *.06*	1.55 *.44*	.19 *.02*	8.92	.62
1.74 *2.35*	[10] .46 *.24*	2.20 *1.29*	(a) (a)	(a) (a)	(a) (a)	(a) (a)	(a) (a)	....	(a) (a)	(a) (a)	[13] .16 *.44*	.38 *.42*	.21 *.13*	(a) (a)	2.38 *2.09*	....	7.16 *2.05*	11.12 *.44*	25.47	.42
1.90 *2.57*	[10] 15.98 *8.41*	....	....	....	....	....	....	....	(a) (a)	....	(a) (a)	....	....	....	(a) (a)	....	32.97 *9.45*	8.55 *.67*	12.79	.58
....	9.00 *4.17*	12.51 *7.36*	(a) (a)	.12 *.03*	(a) (a)	(a) (a)	2.20 *3.28*	(a) (a)	....	2.84 *1.37*	....	1.84 *2.04*	2.07 *1.29*	....	2.23 *1.96*	.35 *.43*	5.95 *1.70*	1.02 *.12*	8.45	.46

TABLE 2.—*Distribution of wage earners among States or State groups, and coefficient of*

Industry (classified according to the Census for 1939)	United States, number of wage earners (thousands)	Maine	New Hampshire, Vermont	Massachusetts	Rhode Island	Connecticut	New York	New Jersey	Pennsylvania	Ohio	Indiana	Illinois	Michigan	Wisconsin	Missouri	Minnesota	Iowa
Total manufacturing	7,887.0	0.96	0.98	5.84	1.35	2.96	12.14	5.50	10.88	7.59	3.52	7.56	6.62	2.55	2.26	1.01	0.83
GROUP 20—MISCELLANEOUS																	
Furs and fur goods	18.2		....	.57	....	(a)	74.96	9.49	3.29	.36	.08	2.83	.89	.61	.50	.98	.25
Location quotient	....	....	....	*.10*	....	(a)	*6.17*	*1.73*	*.30*	*.05*	*.02*	*.37*	*.13*	*.24*	*.22*	*.97*	*.30*
Mattresses and springs	18.3	.35	[10] .19	4.61	.47	1.22	11.02	7.62	5.44	3.88	2.03	12.58	2.22	6.41	3.93	2.31	.17
Location quotient	....	*.36*	*.27*	*.79*	*.35*	*.41*	*.91*	*1.39*	*.50*	*.51*	*.58*	*1.66*	*.34*	*2.51*	*1.74*	*2.29*	*.20*
Fabricated plastics	15.1	....	....	7.90	(a)	12.64	12.85	7.71	14.68	15.41	3.09	13.36	4.45	(a)	(a)	....	....
Location quotient	...	....	....	*1.35*	(a)	*4.27*	*1.06*	*1.40*	*1.55*	*2.03*	*.88*	*1.77*	*.67*	(a)	(a)	....	....

Source: Based on *Census of Manufactures*, 1939.

*States included in this undistributed group are indicated for each industry by footnotes to the respective columns for States or groups of States (see footnotes *a* and 1-34). Note that when State data are undistributed for a given industry they are so classified for total manufacturing.

**The coefficient of localization is the sum, divided by 100, of either the positive or the negative differences between the percentages for the indicated industry and for all manufacturing. Note that the maximum error of the coefficient which may arise from the nondisclosure of industry data for States by the census is always less than *either* the "undistributed for indicated industry" or the "corresponding undistributed portion for total manufacturing" percentages, divided by 100, listed in the 2 preceding columns.

[a] Unavailable. Included in undistributed.
[1] Excludes District of Columbia.
[2] Excludes Nevada.
[3] Excludes Mississippi.
[4] Excludes Oklahoma.
[5] Excludes Kansas.
[6] Excludes Arizona, New Mexico, and Wyoming.
[7] Excludes Delaware and District of Columbia.
[8] Excludes Arizona, Utah, and Nevada.
[9] Excludes North Dakota and South Dakota.
[10] Excludes Delaware.
[11] Excludes Idaho.

Localization of manufacturing is a deviation of a particular industry from the locational pattern of the total of manufacture and represents to that extent reduced locational association between that particular industry and manufacturing in general; therefore, the degree of positive association of any industry with total manufacture can be measured as unity minus the coefficient of localization.

It is important to notice, moreover, in what areas industries locate in relation to other industries or markets. Are they found near their raw materials or their own immediate markets; or are they distributed parallel with the general population?

The answer can be found in the "coefficient of geographic association," an objective measure designed to show whether an industry is linked geographically with some other industry. This coefficient is compiled by methods analogous to those employed for the coefficient of localization, but instead of adding the plus differences between the State percentages of the total workers occupied in the given industry, and the corresponding percentages for manufacture generally, the differences totalled are those between the State percentages in the given industry and in the geographically associated industry. This total of plus differences will vary from zero to one, but ascending values will represent less and less geographic linkage. To avoid confusion, therefore, the coefficient is formulated as the total of the positive differences subtracted from unity.

The picture of a procession of geographically associated processes may be completed by taking the market as measured by the total manufacturing wage earners as the final stage and considering how much the geographic relationships increase as the stages of production approach the market. For example, the coefficient comparing the distributions of automobile factories and producers of stamped and pressed metal is 1.00 minus 0.65, or 0.35.

Table 3 shows a number of coefficients of geographic association as calculated (mainly from table 2)[8] for an alignment of industries that progresses, so far as possible, in order from raw materials toward final consumption. The table is merely suggestive, of course, not comprehensive. It will be seen that, in general, the coefficients of localization (as measuring independence of ultimate markets) tend to be higher for the earlier process industries in each group, such as cotton gray goods and blast furnaces, and become lower as one approaches the service industries, such as baking.

The coefficients comparing the location of automobile factories with that of coal mining, of blast furnaces, and of rolling mills are 0.17, 0.30, and 0.33, respectively.[9] The lowest coefficient (0.17) is shown by the

[8] Because of the apparent absence, in table 2, of various industries in different States, occasioned by the nondisclosure rule of the census, an adjustment of the data in that table has been necessary before they could be used in computing coefficients. For that purpose, the undistributed portion of the wage earners in each industry has been allocated to those States according to the number of establishments. This assumes that the plants in the missing States are all the same size.

[9] In the succession of processes named above, state data on bituminous coal production, reported by the Bituminous Coal Division, Department of the Interior, have been used in preference to census data on the number of coal miners. The method is not limited to homogenous data and can be used to correlate locationally such diverse series as wage earners, "gainful workers," population, or even income-tax data, provided that the measures are comparable among areas.

localization for the United States, selected manufacturing industries, 1939—Continued

North Dakota, South Dakota, Nebraska, Kansas	District of Columbia, Delaware, Maryland	Virginia	West Virginia	North Carolina	South Carolina	Georgia	Florida	Kentucky	Tennessee	Alabama, Mississippi	Arkansas, Oklahoma	Louisiana	Texas	Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada	Washington	Oregon	California	Undistributed for indicated industry[a]	Corresponding undistributed portion for total manufacturing[a]	Coefficient of localization[b]
0.74	2.16	1.70	0.95	3.43	1.61	2.00	0.67	0.89	1.67	2.07	0.82	0.90	1.61	0.88	1.14	0.81	3.49			
(a)	.40	----	----	----	----	----	----	(a)	----	----	----	----	(a)	(a)	.61	(a)	2.32	1.86	6.84	0.67
(a)	*.19*	----	----	----	----	----	----	(a)	----	----	----	----	(a)	(a)	*.54*	(a)	*.66*	*.27*	----	--
[22] 1.23	[10] 2.63	.86	.27	1.53	.51	5.08	1.24	1.34	3.48	1.11	1.27	.76	3.22	1.22	1.60	1.13	7.46	.21	.73	.28
1.73	*1.38*	*.51*	*.28*	*.45*	*.32*	*2.54*	*1.85*	*1.68*	*2.08*	*.54*	*1.55*	*.84*	*2.00*	*1.72*	*.88*	*1.40*	*2.14*	*.29*		--
----	(a)	----	----	----	----	----	----	----	(a)	----	----	----	----	----	(a)	(a)	2.46	5.45	11.84	.32
----	(a)	----	----	----	----	----	----	----	(a)	----	----	----	----	----	(a)	(a)	*.70*	*.46*	-	--

[12] Excludes New Mexico.
[13] Excludes Arkansas.
[14] Excludes Montana and New Mexico.
[15] Excludes Arizona.
[16] Excludes New Hampshire.
[17] Excludes Arizona, Nevada, New Mexico, and Wyoming.
[18] Excludes Vermont.
[19] Excludes Arizona and New Mexico.
[20] Excludes Nebraska.
[21] Excludes Wyoming.
[22] Excludes North Dakota.
[23] Excludes South Dakota.
[24] Excludes Alabama.
[25] Excludes Utah.
[26] Excludes Arizona, Colorado, and New Mexico.
[27] Excludes Maryland.
[28] Excludes Idaho and Nevada.
[29] Excludes Nevada, New Mexico, and Wyoming.
[30] Excludes Montana, Nevada, and New Mexico.
[31] Excludes Arizona and Montana.
[32] Excludes Arizona and Nevada.
[33] Excludes Montana, Nevada, and Wyoming.
[34] Excludes Nevada and Wyoming.

relative location of coal mining and automobile factories, which are at the opposite ends of the production process. This tendency may be illustrated further by the geographic relationship between wheat output and the successive manufacturing processes needed in adapting it for human consumption. Between wheat production itself, closely connected with natural resources, and flour milling, the relationship is 0.64; between wheat production and bread baking it is only 0.40. Between flour milling and bread baking the relationship is 0.54; and between bread baking and population it is 0.81. Wheat production shows a geographic linkage with population of only 0.46.

These coefficients suggest the generalization that the further separated two industries may be in the vertical process of production, the lower is their geographic association likely to be. It appears true in America, though further confirmation is required, that processes tend to be associated regionally with the next in succession; but where there is a series of successive processes, the head of the procession may be located far away from the tail.[10] There is a significant exception in automobile factories which, though nearer the market than "other iron and steel," have a higher localization coefficient. Clearly, some special factors deflect automobile factories from the market and must be taken into account in planning location.[11]

TABLE 3.—*Geographic association between selected industries and other items, 1939* [1]

[Calculated by States or groups of States [2]]

Industry (or item)	Industry (or item)	Coefficient of geographic association (columns 1 and 2)
(1)	(2)	(3)
Total population	Total wage earners in manufacturing	0.78
Wheat production (bushels)	Flour milling	.64
	Bread baking	.40
	Total population	.46
Flour milling	Bread baking	.54
Bread baking	Biscuit and cracker baking	.87
	Total population	.81
Bituminous coal production (tons).	Blast furnaces	.49
	Steel works and rolling mills	.50
	Stamped and pressed metal	.31
	Electric generating equipment	.36
	Motor vehicles and bodies	.17
	Hardware [3]	.30
Blast furnaces	Steel works and rolling mills	.79
	Stamped and pressed metal	.50
	Electric generating equipment	.54
	Motor vehicles and bodies	.30
	Hardware [3]	.37
Steel works and rolling mills	Stamped and pressed metal	.55
	Electric generating equipment	.55
	Motor vehicles and bodies	.33
	Hardware [3]	.37
Stamped and pressed metal	Motor vehicles and bodies	.35
	Hardware [3]	.54

[1] The number of wage earners in each industry has been used in the computations unless otherwise indicated.
[2] See table 2 for grouping of States.
[3] Not elsewhere classified.

The local coincidence of different industries as measured by the coefficient of geographic association may be only an accident but it is usually due to some logical connection between the industries. The coincident industries may use the same factors of production, produce from the same raw material, or employ labor of the same skill. They may use jointly supplied factors; one industry, for instance, may employ the men, another industry the women of an area. They may

[10] Cf. Political and Economic Planning (P. E. P.), *Report on the Location of Industry in Great Britain*, London, 1935.
[11] This does not mean that the concentration of certain industries (including automobile manufacture) in particular areas does not exceed the degree economically or socially desirable.

converge on the same special markets. Or the coincident industries may be more directly related. The product or byproduct of one industry may provide the raw material for the other, as in the procession from coal to automobiles; or one industry may provide services, such as making machine tools, for the other.

Clearly, then, if two or more industries show a markedly similar geographic distribution and there is some logical linkage discoverable, there is a presumption, of which planning policy should take due heed, against locating one of the industries away from the others. There may, of course, be a logical relationship not disclosed by the relative locations of the industries. The coefficient of geographic association of employed workers in fishing (1940) and fish canning, as reported for 1939, is only 0.37; this is because so much of the eastern catch is consumed fresh. Based on west coast figures only, the linkage would be much closer. As often happens, industry B is here more dependent on industry A than industry A on industry B.

Specialization and Economic Balance

Many localities and States maintain that there is not a proper diversity of their economic activities, and that such diversity is necessary to economic and social security.

A State may be deemed to specialize to the extent that its economic structure differs from the basic pattern of the United States as a whole. If certain activities, such as agriculture or cotton textiles, form a larger proportion of total economic activities in a State than they do in the basic pattern of the United States, then the State may be said to specialize, at least to some extent, in those activities. If, on the other hand, a State contains all the economic activities that exist in the United States and contains them in exactly the same proportions, its economy is as balanced and diversified as the nation considered as a unit.

Table 4 gives the percentage distribution of employed workers in 1940 for 18 manufacturing and 15 other industry groups in the United States, whereas table 5 shows for an exactly similar industry classification the extent to which the percentage of employed persons in industry in each geographic division or State varies from that of the country as a whole.[12] Since both State and national percentages add up to 100, the plus deviations of State from National percentages must add up to the same total as the minus deviations. This total of deviations (either plus or minus) forms a "coefficient of specialization"[13] which gives a general picture of the deviation of the State's economic activities from those of the United States, and thus shows how far that State specializes in certain activities (see first line of table 5). Since the deviations are percentages, the total is divided by 100. The degree of specialization in order of rank is shown for geographic divisions and States in the first column of table 6. It is not meant to imply here that diversification is necessarily better than specialization, or that perfect diversity is the only criterion. The purpose of the tables is to summarize and compare the distribution of economic activities in the several States so that whatever policies are adopted can be effectively implemented. It will be noted that no State or division has a cofficient of specialization above 0.421 (table 6), although in theory, if any area concentrated entirely on one activity, the coefficient would be very close to 1.00. This lowness of the coefficients reflects the fact that no area, unless it be very small, can specialize in one

TABLE 4.—*Percentage distribution of employed workers in major industry groups, United States, 1940*

[Percentage of national total]

Total employed (45,166,083)	100.0
Major industry groups:	
Manufacturing (subdivided below)	23.41
Agriculture	18.54
Forestry and fishing	0.23
Construction	4.55
Coal mining	1.17
Oil and gas wells	0.41
Other mines and quarries	0.45
Transportation, communication, etc	6.89
Wholesale and retail trade	16.69
Finance, insurance, and real estate	3.25
Business and repair services	1.91
Personal services	8.88
Amusement, recreation, etc	0.88
Professional and related services	7.35
Government	3.88
Industry not reported	1.53
Subdivisions of manufacturing (total: 23.41 percent):	
Food and kindred products	2.42
Textile-mill products	2.59
Apparel and other fabricated textile products	1.73
Logging	0.31
Sawmills and planing mills	0.96
Furniture, store fixtures, and miscellaneous wooden goods	0.30
Paper and allied products	0.73
Printing, publishing, and allied industries	1.40
Chemicals and allied products	0.97
Petroleum and coal products	0.45
Leather and leather products	0.81
Stone, glass, and clay products	0.75
Iron and steel and their products	2.80
Nonferrous metals and their products	0.62
Machinery	2.37
Automobile and automobile equipment	1.27
Transportation equipment except automobiles	0.68
Other and not specified manufacturing industries	1.76

SOURCE: Based on *Census of Population,* 1940.

[12] The basic data for these tables are to be found in table 2, pp. 108–119. The number of persons employed and the classification of economic activities were taken from the *Census of Population,* 1940.

[13] To make clear how the coefficient of specialization is obtained, an example may be worked out from the first State, Maine, listed in table 5. All of the States have 33 deviations on which to build the coefficient of specialization. Since the subdivisions of manufacturing are used, no account should be taken of the deviation for manufacturing as a whole. Adding the plus deviations of which (omitting that for manufacturing as a whole) there are 12, a total is obtained of 21.95. Adding the minus deviations, of which there are 21, a total is obtained of 21.99. The two totals, as mentioned above, should be equal; and the discrepancy of the plus and minus totals is due, of course, to tabulating percentages only to the second place of decimals. Dividing by 100 gives a coefficient of specialization for Maine in 1940 of 0.220.

economic activity only. There must always be certain "residentiary" industries servicing the community, such as retail trade, transport (including communication), and public, domestic and professional services. The proportion of these activities to the total economic activities of a major area does not show any extreme deviation from the national proportion.

Changes in Location Patterns

The distribution of industry in general and of particular industries is, of course, continually changing, a fact that must be taken into account in planning location, since the plant to be located will be operating in the future, and it is the future conditions, so far as they may be computed, that are of greatest practical

TABLE 5.—*Deviations from the United States industrial pattern, by divisions and States, 1940*

[Based on point deviations in percentage distribution of employed workers]

	Division									New England						Middle Atlantic		
	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific	Maine	New Hampshire	Vermont	Massachusetts	Rhode Island	Connecticut	New York	New Jersey	Pennsylvania
Rank [1]	7	3	1	2	4	9	8	6	5	29	37	8	28	42	39	22	23	13
Coefficient of specialization [2]	0.200	0.164	0.133	0.164	0.176	0.258	0.207	0.179	0.177	0.220	0.269	0.160	0.219	0.306	0.270	0.202	0.203	0.178
Deviation + or − from United States percentage:																		
Agriculture	−13.64	−13.93	−5.21	13.52	6.31	22.35	15.26	7.49	−6.61	−5.47	−9.77	5.92	−16.20	−16.64	−14.65	−14.31	−15.48	−12.58
Forestry and fishing	.14	−.17	−.16	−.18	.44	−.03	.05	.01	.18	.93	.13	−.02	−.15	0	−.10	−.17	−.11	−.20
Coal mining	−1.17	.92	−.43	−.89	.91	1.39	−1.08	.25	−1.09	−1.16	−1.17	−1.17	−1.17	−1.16	−1.17	−1.17	−1.16	5.16
Oil and gas wells	−.41	−.28	−.21	−.17	−.32	−.29	2.03	.08	.29	−.41	−.41	−.41	−.41	−.41	−.41	−.36	−.41	−.09
Other mines and quarries	−.30	−.24	−.17	−.06	−.16	.01	−.17	4.02	.31	−.26	−.27	.71	−.36	−.39	−.37	−.32	−.23	−.13
Construction	.08	.19	−.43	−.51	.12	−.70	.02	.71	1.41	−.23	.57	−.08	−.08	.38	.34	.32	.45	−.13
Manufacturing	14.82	7.31	8.14	−11.08	−2.92	−8.88	−13.31	−14.99	−5.54	9.43	16.10	−1.45	13.35	22.40	20.05	3.88	13.04	9.80
Transportation, communication, etc	−1.02	1.17	.34	.28	−1.28	−2.05	−.89	1.41	1.12	−.73	−1.80	−.61	−.37	−2.08	−2.04	1.41	1.20	.80
Wholesale and retail trade	.25	1.49	.82	.79	−3.50	−5.50	−.51	.74	4.35	−1.71	−2.52	−3.64	2.05	.18	−1.55	3.07	.21	−.33
Finance, insurance, and real estate	.37	1.67	−.16	−.36	−1.15	−1.73	−.95	−.94	1.08	−1.38	−1.25	−1.24	.83	−.51	1.09	2.75	2.37	−.33
Business and repair services	−.06	.21	.10	.17	−.58	−.68	−.10	.35	.67	.05	.02	.15	.02	−.30	−.24	.46	.10	−.11
Personal services	−.43	.05	−1.58	−1.46	2.45	.59	1.54	−1.45	.03	.55	.28	.98	−.44	−1.54	.82	1.04	−.58	−1.18
Amusement, recreation, etc	−.16	.10	−.07	−.14	−.22	−.45	−.14	.07	1.12	−.24	−.30	−.39	−.07	−.21	−.26	.36	−.12	−.20
Professional and related services	1.23	.97	−.16	.63	−1.35	−2.21	−.97	1.11	1.05	−.01	.61	.48	2.08	−.08	.61	1.78	.25	.07
Government	.07	−.05	−.73	−.54	1.42	−1.45	−.51	1.13	1.81	.18	−.61	.28	.37	.62	−.71	.50	−.37	−.74
Industry not reported	.22	.57	−.16	−.13	−.18	−.39	−.29	−.01	−.20	.43	.38	.46	.22	−.29	.22	.76	.83	.16
Manufacturing subdivided:																		
Food and kindred products	−.51	.04	.59	.90	−.75	−.88	−.48	−.45	.53	−.56	−1.29	−.70	−.06	−.91	−1.09	−.01	.13	.09
Textile mill products	6.19	.57	−2.05	−2.42	4.14	.08	−2.30	−2.17	−2.33	5.77	6.44	.68	5.68	19.02	3.28	−.53	1.44	1.84
Apparel and other fabricated textile production	.12	2.80	−.63	−.88	−.71	−.75	−1.33	−1.60	−.96	−1.18	−1.42	−1.00	.39	−.63	.93	3.97	2.46	1.16
Logging	.06	−.25	−.20	−.18	.16	.10	.14	.06	.88	1.85	1.29	.77	−.26	−.27	−.27	−.27	−.30	−.21
Sawmills and planing mills	−.52	−.78	−.57	−.60	.90	1.23	.73	−.13	1.34	.55	.60	1.35	−.82	−.86	−.80	−.83	−.84	−.68
Furniture, store fixtures, and miscellaneous wooden goods	.12	−.05	.39	−.42	.19	−.17	−.33	−.61	0	.87	1.41	1.07	.11	−.44	−.46	.02	−.18	−.10
Paper and allied products	1.15	.21	.28	−.44	−.26	−.47	−.41	−.69	−.13	4.28	2.93	.41	1.16	−.23	.07	.30	.15	.11
Printing, publishing, and allied industries	.13	.53	.40	−.10	−.57	−.77	−.63	−.41	.11	−.60	−.29	−.49	.52	−.30	−.07	.94	.32	−.01
Chemicals and allied products	−.19	.48	−.01	−.50	.50	−.07	−.52	−.78	−.38	−.78	−.83	−.83	−.03	−.44	.07	.20	2.33	0
Petroleum and coal products	−.30	.12	−.06	−.22	−.33	−.32	.90	−.14	.19	−.40	−.43	−.44	−.25	−.14	−.36	−.19	.83	.24
Leather and leather products	2.92	.30	−.03	−.02	−.52	−.53	−.77	−.76	−.69	5.47	11.54	−.28	3.76	−.55	−.34	.57	−.08	.07
Stone, glass, and clay products	−.21	.28	.36	−.25	−.07	−.28	−.40	−.44	−.22	−.48	−.23	2.02	−.29	−.48	−.38	−.17	.64	.80
Iron and steel and their products	.74	1.33	2.68	−1.86	−1.58	−1.06	−2.45	−2.09	−1.60	−2.20	−2.08	−2.09	−.08	1.99	4.56	−1.07	−.03	5.71
Nonferrous metals and their products	1.35	.20	.22	−.42	−.45	−.34	−.45	−.44	−.29	−.57	−.51	−.57	.31	.73	5.59	.18	.48	.11
Machinery	2.29	.74	2.68	−1.16	−1.98	−1.95	−1.79	−2.06	−1.30	−1.12	−.29	.69	2.19	2.28	4.90	.21	2.22	.82
Automobile and automobile equipment	−1.06	−.71	3.77	−.95	−1.13	−1.12	−1.17	−1.21	−.87	−1.24	−1.24	−1.26	−1.02	−1.19	−.95	−.76	−.44	−.75
Transportation equipment except autos	.64	.35	−.30	−.53	.08	−.56	−.55	−.65	1.18	1.02	.68	−.66	.54	−.57	1.39	.08	1.27	.33
Other and not specified manufacturing industries	1.96	1.14	.63	−1.05	−.56	−1.02	−1.52	−1.31	−1.00	−1.26	−.19	−.13	1.50	5.39	3.95	1.23	2.62	.28

[1] Most diversified ranked first.
[2] The coefficient of specialization measures the extent to which the industrial pattern of each State differs from that of the United States as a whole. The number of persons employed in the several economic activities are expressed as percentages of the total employed in each State and in the United States. The percentages for each State are subtracted from the national percentages and the sum of either the plus or the minus differences is divided by 100.

TABLE 5.—*Deviations from the United States industrial pattern, by Divisions and States, 1940*—Continued

	Division											
	East North Central					West North Central						
	Ohio	Indiana	Illinois	Michigan	Wisconsin	Minnesota	Iowa	Missouri	North Dakota	South Dakota	Nebraska	Kansas
Rank[1]	6	2	5	25	3	10	21	1	45	44	31	19
Coefficient of specialization[2]	0.158	0.108	0.156	0.212	0.145	0.169	1.98	0.107	0.354	0.320	0.225	1.93
Deviation + or − from United States Percentage:												
Agriculture	−7.57	−.75	−8.66	−6.82	7.24	11.76	17.24	5.01	34.84	29.52	18.83	12.87
Forestry and fishing	−.19	−.20	−.19	−.11	−.07	−.15	−.20	−.19	−.20	−.16	−.18	−.20
Coal mining	−.18	−.31	.03	−1.12	−1.17	−1.17	−.57	−.86	−.70	−1.14	−1.17	−.76
Oil and gas wells	−.27	−.31	−.03	−.24	−.41	−.41	−.40	−.38	−.40	−.40	−.39	1.34
Other mines and quarries	−.20	−.24	−.32	.20	−.22	.39	−.32	.17	−.43	.91	−.33	----------
Construction	−.23	−.19	−.47	−.54	−.83	−.53	−.35	−.19	−2.52	−1.51	−.63	−.29
Manufacturing	9.99	6.60	5.17	14.95	2.07	−10.96	−11.97	−4.53	−20.91	−18.88	−16.65	−14.32
Transportation, communications, etc	.52	.07	2.08	−1.39	−1.16	.11	−.32	.74	−1.82	−2.52	.90	1.63
Wholesale and retail trade	.74	−.35	2.82	−.48	−.90	1.85	.11	1.67	−2.98	−2.02	.50	.69
Finance, insurance, and real estate	−.39	−.75	.83	−.62	−.92	−.17	−.72	.11	−1.68	−1.52	−.05	−.60
Business and repair serivces	.05	−.03	.39	−.07	−.09	.19	.14	.15	−.05	.07	.27	.25
Personal services	−1.33	−2.05	−1.06	−1.96	−2.32	−1.42	−2.18	−.41	−2.79	−3.20	−1.70	−1.56
Amusement, recreation, etc	−.06	−.17	.05	−.09	−.23	−.06	−.18	−.15	−.33	−.14	−.12	−.13
Professional and related services	.01	−.36	−.03	−.62	.14	1.22	.59	−.20	.53	1.40	1.05	1.02
Government	−.77	−1.03	−.41	−.86	−.98	−.36	−1.13	−.81	−.35	−.25	−.03	.12
Industry not reported	−.14	.06	−.21	−.25	−.17	−.31	.24	−.16	−.23	−.19	−42	−.06
Manufacturing subdivided:												
Food and kindred products	−.17	.63	1.55	−.29	1.18	1.34	1.42	.65	−1.03	.07	.98	.89
Textile mill products	−2.15	−1.86	−2.11	−2.24	−1.51	−2.21	−2.43	−2.39	−2.58	−2.57	−2.56	−2.57
Apparel and other fabricated textile production	.73	−.25	−.03	−1.33	−1.27	−1.13	−1.40	.33	−1.70	−1.70	−1.59	−1.33
Logging	−.28	−.25	−.29	−.03	----------	----------	−.28	−.14	−.30	−.18	−.30	−.28
Sawmills and planing mills	−.71	−.45	−.75	−.56	.08	−.57	−.47	−.44	−.94	−.60	−.89	−.85
Furniture, store fixtures, and miscellaneous wooden goods	.06	.88	.38	.45	.45	−.34	.45	−.21	−.77	−.75	−.61	−.58
Paper and allied products	.24	−.18	.01	.37	1.34	−.20	−.62	−.28	−.73	−.72	−.66	−.54
Printing, publishing, and allied industries	.33	−.14	1.18	−.14	−.06	.05	−.21	.09	−.81	−.64	−.24	−.09
Chemicals and allied products	.19	−.24	.08	.07	−.57	−.57	−.64	−.12	−.95	−.88	−.79	−.51
Petroleum and coal products	−.08	.25	.09	−.27	−.39	−.37	−.42	−.18	−.42	−.40	−.37	.45
Leather and leather products	−.08	−.54	.18	−.54	.93	−.67	−.72	1.75	−.80	−.78	−.75	−.78
Stone, glass, and clay products	1.41	.65	.06	−.24	−.45	−.20	−.28	.04	−.71	−.61	−.56	−.42
Iron and steel and their products	5.96	3.47	1.94	.66	.04	−1.76	−1.84	−1.23	−2.76	−2.76	−2.55	−2.27
Nonferrous metals and their products	.19	−.05	.42	.11	.19	−.42	−.51	−.26	−.58	−.57	−.51	−.46
Machinery	3.47	2.65	3.22	.96	2.49	−1.11	−.54	−.69	−2.23	−2.18	−1.93	−1.92
Automobile and automobile equipment	.63	1.76	−.79	18.22	.40	−1.02	−1.20	−.47	−1.24	−1.26	−1.20	−1.15
Transportation equipment except autos	−.27	−.11	−.30	−.39	−.44	−.62	−.63	−.38	−.68	−.68	−.63	−.38
Other and not specified manufacturing industries	1.96	.37	.32	.13	−.35	−1.16	−.77	−.61	−1.69	−1.68	−1.39	−1.54

	Division												
	South Atlantic									East South Central			
	Delaware	Maryland	District of Columbia	Virginia	West Virginia	North Carolina	South Carolina	Georgia	Florida	Kentucky	Tennessee	Alabama	Mississippi
Rank[1]	11	7	48	12	36	43	46	38	14	32	20	41	49
Coefficient of specialization[2]	0.174	0.158	0.390	0.175	0.267	0.319	0.370	0.269	0.182	0.232	0.194	0.303	0.421
Deviation + or − from U. S. percentage:													
Agriculture	−4.83	−8.62	−18.37	5.33	−3.26	15.04	20.91	15.37	−1.45	17.93	14.59	21.03	39.14
Forestry and fishing	−.06	.38	−.22	.51	−.17	.03	−.07	.99	1.60	−.18	−.12	.09	.12
Coal mining	−1.17	−.76	−1.17	.98	19.23	−1.16	−1.17	−1.15	−1.17	5.28	−.16	1.41	−1.17
Oil and gas wells	−.40	−.41	−.41	−.41	.65	−.41	−.41	−.41	−.40	−.11	−.40	−.40	−.23
Other mines and quarries	−.36	−.28	−.42	−.02	−.07	−.22	−.25	−.11	−.08	−.06	.06	.34	−.37
Construction	2.24	1.14	1.84	.65	−.56	−.66	−1.17	−.79	1.85	−.35	−.01	−1.33	−1.23
Manufacturing	5.47	2.71	−16.21	−3.30	−5.77	3.52	−.58	−4.88	−11.68	−11.52	−5.10	−6.02	−14.23
Transportation, communication, etc	.82	1.56	−.05	−.02	.65	−3.49	−3.99	−2.18	−.24	−.66	−1.44	−2.59	−3.89
Wholesale and retail trade	−2.33	−.08	.33	−4.30	−4.29	−6.21	−7.33	−4.98	3.68	−4.14	−3.35	−6.63	−8.49
Finance, insurance and real estate	−.45	.11	1.48	−1.22	−1.83	−1.97	−2.03	−1.50	−.21	−1.46	−1.32	−1.83	−2.44
Business and repair services	−.21	−.11	−.20	−.64	−.60	−.80	−1.01	−.74	−.08	−.34	−.48	−.91	−1.06
Personal services	1.44	1.13	6.29	1.23	−1.71	−.67	1.88	4.01	8.19	−1.31	1.49	1.71	.26
Amusement, recreation, etc	−.24	.01	.00	−.35	−.31	−.41	−.49	−.38	−.57	−.32	−.41	−.51	−.57
Professional and related services	−.80	−.13	2.31	−1.41	−.53	−2.08	−2.39	−2.38	−.86	−1.81	−1.61	−2.50	−3.10
Government	−.13	2.78	25.09	3.19	−1.31	−1.65	−1.26	−.46	.28	−.81	−1.41	−1.49	−2.19
Industry not reported	.98	.55	−.32	−.24	−.14	−.23	−.66	−.44	−.02	−.24	−.37	−.40	−.57
Manufacturing subdivided:													
Food and kindred products	.05	.91	−1.39	−.73	−1.34	−1.30	−1.53	−.78	−.04	−.29	−.70	−1.28	−1.32
Textile mill products	.59	−1.76	−2.57	.66	−1.91	13.13	12.61	5.07	−2.53	−2.18	1.38	2.41	−1.85
Apparel and other fabricated textile production	.20	1.64	−1.68	−.68	−1.34	−1.21	−1.37	−.25	−1.58	−.75	−.22	−1.33	−.74
Logging	−.25	−.22	−.31	.13	.42	.20	.22	.09	.61	−.08	.04	.13	.32
Sawmills and planing mills	−.28	−.50	−.92	1.34	.47	1.31	1.42	1.28	1.23	−.03	.74	2.09	2.29
Furniture, store fixtures and misc. wooden goods	.12	−.20	−.71	.52	−.54	1.22	−.24	−.10	.15	−.06	.18	−.51	−.32
Paper and allied products	−.48	−.15	−.63	.04	−.37	−.30	−.30	−.35	−.26	−.63	−.47	−.32	−.49
Printing, publishing and allied industries	−.61	.19	1.68	−.64	−.81	−.95	−1.07	−.81	−.48	−.53	−.53	−.96	−1.14
Chemicals and allied products	8.06	1.37	−.87	1.24	1.95	−.21	−.32	.10	−.27	−.67	.91	−.31	−.34
Petroleum and coal products	.08	−.06	−.43	−.38	−.12	−.43	−.41	−.36	−.40	−.22	−.38	−.26	−.42
Leather and leather products	1.59	−.18	−.80	−.21	−.50	−.70	−.80	−.56	−.79	−.44	−.15	−.79	−.81
Stone, glass and clay products	−.52	.05	−.56	−.26	2.57	−.40	−.44	−.24	−.43	−.34	−.15	−.29	−.38
Iron and steel and their products	−.88	2.16	−.83	−2.26	.79	−2.62	−2.71	−2.31	−2.59	−1.40	−1.43	1.05	−2.75
Nonferrous metals and their products	−.40	−.03	−.55	−.52	−.16	−.50	−.60	−.54	−.55	−.34	.03	−.53	−.60
Machinery	−1.77	−1.13	−2.18	−2.16	−1.91	−2.13	−2.21	−1.98	−2.13	−1.47	−2.01	−2.10	−2.27
Automobile and automobile equipment	−1.16	−.85	−1.24	−1.11	−1.25	−1.20	−1.24	−1.03	−1.20	−1.03	−1.00	−1.23	−1.25
Transportation equipment except autos	1.18	1.82	−.64	1.51	−.53	−.64	−.18	−.65	−.29	−.62	−.64	−.42	−.54
Other and not specified manufacturing industries	−.04	−.36	−1.60	.20	−1.18	.25	−1.40	−1.45	−.13	−.44	−.71	−1.39	−1.63

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TABLE 5.—*Deviations from the United States industrial pattern, by divisions and States, 1940*—Continued

	Division														
	West South Central				Mountain								Pacific		
	Arkansas	Louisiana	Oklahoma	Texas	Montana	Idaho	Wyoming	Colorado	New Mexico	Arizona	Utah	Nevada	Washington	Oregon	California
Rank [1]	47	30	26	16	33	34	35	4	27	17	15	40	24	9	18
Coefficient of specialization [2]	0.371	0.223	0.212	0.188	0.237	0.247	0.265	01.45	0.214	0.189	0.183	0.283	0.204	0.164	0.189
Deviation + or − from U. S. percentage:															
Agriculture	32.85	13.71	14.57	11.22	13.30	18.11	10.85	2.49	13.47	2.99	.63	−3.28	−4.80	−.24	−8.03
Forestry and fishing	.02	.73	−.20	−.10	.14	.23	−.06	−.09	−.03	−.02	−.01	−.09	.59	.30	.06
Coal mining	−.89	−1.17	−.94	−1.14	−.33	−1.15	3.61	1.04	.44	−1.15	.32	−.17	−.74	−1.16	−1.17
Oil and gas wells	−.01	1.30	4.11	2.20	.02	−.39	1.63	−.32	1.79	−.38	−.37	−.39	−.40	−.40	.56
Other mines and quarries	−.12	−.24	.11	−.24	5.57	3.76	−.01	1.79	2.04	8.02	4.81	14.63	.00	.29	.39
Construction	−1.60	−.02	−.47	.63	.21	−.02	.24	.56	1.41	1.33	.85	2.82	1.61	.76	1.46
Manufacturing	−13.53	−10.56	−15.71	−13.51	−16.00	−15.49	−18.09	−13.24	−17.01	−15.02	−12.45	−18.90	−1.85	−2.48	−6.90
Transportation, communication, etc	−2.62	−.34	−1.83	−.33	1.13	−.32	3.50	1.40	−.26	.63	3.58	5.57	1.59	1.01	1.02
Wholesale and retail trade	−5.68	−2.09	.55	1.14	−.89	−.33	−2.43	2.57	−1.27	1.61	2.72	−.26	2.42	2.22	5.15
Finance, insurance, and real estate	−2.03	−1.31	−.67	−.62	−1.35	−1.56	−1.77	.06	−1.84	−1.27	−.29	−1.61	.28	−.24	1.48
Business and repair services	−.66	−.46	.23	.09	.19	.21	.16	.69	.18	.20	.33	.23	.39	.46	.78
Personal services	−1.00	3.28	−.36	2.19	−2.87	−2.84	−2.39	−.50	−.72	.65	−2.83	−.84	−1.55	−1.28	.62
Amusement, recreation, etc	−.38	−.11	−.05	−.11	−.09	.05	−.09	.01	−.15	.23	.11	1.79	.06	.08	1.53
Professional and related services	−2.46	−1.33	.51	−.88	.28	.01	31	2.11	1.18	1.36	1.57	−.60	.50	.66	1.24
Government	−1.70	−.91	−.02	−.18	.90	−.33	4.94	1.27	.59	.94	1.00	1.65	2.06	−.04	2.03
Industry not reported	−.20	−.53	−.13	−.37	−.25	.03	−.42	.14	.17	−.15	.02	.43	−.17	.05	−.25
Manufacturing subdivided:															
Food and kindred products	−1.35	.28	−.58	−.48	−.92	−.53	−1.20	.37	−1.61	−.89	.52	−1.45	.33	.06	.65
Textile mill products	−.244	−2.23	−2.45	−2.24	−2.57	−2.57	−2.58	−2.54	−1.16	−1.03	−2.09	−2.58	−2.47	−1.97	−2.35
Apparel and other fabricated textile production	−1.47	−1.24	−1.64	−1.23	−1.69	−1.69	−1.70	−1.53	−1.69	−1.70	−1.32	−1.69	−1.36	−1.35	−.80
Logging	.76	.39	−.04	−.07	.24	.99	−.03	−.19	−.08	.03	−.26	−.28	3.21	3.75	−.12
Sawmills and planing mills	3.37	1.65	−.43	.03	25	1.30	−.48	−.64	.04	−.07	−.75	−.73	4.75	6.19	−.23
Furniture, store fixtures and misc. wooden goods	.07	−.29	−.56	−.37	−.71	−.68	−.65	−.59	−.61	−.39	−.57	−.74	.05	.35	−.07
Paper and allied products	−.32	.31	−.69	−.60	−.72	−.72	−.73	−.63	−.73	−.72	−.65	−.72	.85	.19	−.42
Printing, publishing and allied industries	−.95	−.79	−.45	−.54	−.55	−.51	−.66	−.16	−.78	−.48	−.08	−.63	−.11	−.09	.19
Chemicals and allied products	−.67	−.15	−.77	−.53	−.93	−.94	−.94	−.68	−.75	−.71	−.61	−.82	−.66	−.76	−.26
Petroleum and coal products	−.25	.64	.98	1.29	−.03	−.38	1.27	−.27	−.25	−.43	−.09	−.43	−.39	−.39	.42
Leather and leather products	−.80	−.80	−.80	−.75	−.79	−.79	−.79	−.69	−.79	−.77	−.77	−.79	−.76	−.73	−.67
Stone, glass and clay products	−.49	−.27	−.31	−.44	−.64	−.60	−.49	−.28	−.34	−.53	−.32	−.61	−.41	−.50	−.13
Iron and steel and their products	−2.69	−2.46	−2.38	−2.40	−2.68	−2.74	−2.74	−.82	−2.72	−2.58	−2.03	−2.76	−1.96	−2.07	−1.44
Nonferrous metals and their products	−.54	−.53	−.33	−.44	1.46	−.12	−.58	−.30	.07	.86	1.82	1.16	−.23	−.45	−.28
Machinery	−2.24	−2.08	−1.83	−1.56	−2.17	−2.14	−2.20	−1.82	−2.25	−2.13	−2.03	−2.26	−1.84	−1.79	−1.09
Automobile and automobile equipment	−1.22	−1.21	−1.22	−1.13	−1.25	−1.25	−1.26	−1.15	−1.26	−1.23	−1.20	−1.25	−1.14	−1.15	−.77
Transportation equip. except autos	−.67	−.41	−.64	−.54	−.67	−.55	−.64	−.66	−.66	−.66	−.66	−.67	1.65	−.55	1.33
Other and not specified manufacturing industries	−1.61	−1.39	−1.58	−1.51	−1.65	−1.59	−1.70	−.68	−1.43	−1.58	−1.38	−1.67	−1.37	−1.25	−.87

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TABLE 6.—*Industrial specialization, degree and rank, by geographic divisions and states, 1940*

	Coefficient of specialization	Rank [1]		Coefficient of specialization	Rank [1]	Direction of specialization
Division:			State—Continued.			
East North Central	0.133	1	Tennessee	0.194	20	Agriculture.
West North Central	.164	2	Iowa	.198	21	Do.
Middle Atlantic	.164	3	New York	.202	22	Trade.
South Atlantic	.176	4	New Jersey	.203	23	Manufacturing.
Pacific	.177	5	Washington	.204	24	Trade.
Mountain	.179	6	Michigan	.212	25	Manufacturing.
New England	.200	7	Oklahoma	.212	26	Agriculture, oil.
West South Central	.207	8	New Mexico	.214	27	Do.
East South Central	.258	9	Massachusetts	.219	28	Manufacturing.
State:			Maine	.220	29	Do.
Missouri	.107	1	Louisiana	.223	30	Agriculture.
Indiana	.108	2	Nebraska	.225	31	Do.
Wisconsin	.145	3	Kentucky	.232	32	Do., coal.
Colorado	.145	4	Montana	.237	33	Do., minerals.
Illinois	.156	5	Idaho	.247	34	Do.
Ohio	.158	6	Wyoming	265	35	Do.
Maryland	.158	7	West Virginia	267	36	Coal.
Vermont	.160	8	New Hampshire	269	37	Manufacturing.
Oregon	.164	9	Georgia	.269	38	Agriculture.
Minnesota	.169	10	Connecticut	.270	39	Manufacturing.
Delaware	.174	11	Nevada	.283	40	Minerals, transport.
Virginia	.175	12	Alabama	303	41	Agriculture.
Pennsylvania	.178	13	Rhode Island	.306	42	Manufacturing.
Florida	.182	14	North Carolina	.319	43	Agriculture.
Utah	.183	15	South Dakota	.320	44	Do.
Texas	.188	16	North Dakota	.354	45	Do.
Arizona	.189	17	South Carolina	.370	46	Do.
California	.189	18	Arkansas	.371	47	Do.
Kansas	.193	19	District of Columbia	.390	48	Government.
			Mississippi	.421	49	Agriculture.

Source: Table 5.

[1] Most diversified ranked first.

TABLE 7.—*Coefficients of geographic association for selected items, decennial census years 1899–1939*

[All manufacturing items represented by wage earners]

First item	Second item (Related to first item)	1899	1909	1919	1929	1939
Population	Land area	0.52	0.55	0.56	0.57	0.58
	Total manufacturing	.73	.75	.75	.78	.78
	Boot and shoe production	.45	.43	.43	.46	.48
	Slaughtering and meat packing	.45	.55	.52	.59	.62
Total manufacturing	Land area	.37	.38	.39	.41	.40
	Boot and shoe production	.53	.51	.52	.52	.55
	Slaughtering and meat packing	.39	.47	.45	.55	.54
Boot and shoe production	Land area	.18	.19	.18	.20	.20
Slaughtering and meat packing	Land area	.26	.34	.37	.41	.47

importance. This change can be measured by changes in regional densities of population, in the urbanization quotient, in the location quotient, and the coefficients of localization and geographic association.

Owing to the specific significance of the coefficient of geographic association, this measure has been computed for the decennial census years from 1899 to 1939 for the relationships among total wage earners in manufacturing, population, land area, and wage earners in two specific industries, boot and shoe, and slaughtering and meat-packing industries (table 7). Here again high or rising coefficients indicate, respectively, close or increasing geographic association. All of the items considered showed somewhat closer geographic association in 1939 than in 1899. Although in most cases, the gain was only moderate, the association of slaughtering and meat packing with population, with wage earners in total manufacturing, and with land area increased markedly during the period. This increase reflects the wider dispersion among the population and area that took place in the industry.

The extent of redistribution of industry among areas is indicated by "coefficients of redistribution" shown in table 8 for population and for wage earners in total manufacturing, in boot and shoe production, and in slaughtering and meat packing.[14] This coefficient is the sum of the positive (or negative) differences between census years in the percentage distribution among States of population and of the other items considered. Complete redistribution, i. e., a shift from zero to a finite percentage or vice versa in all States, would be represented by a coefficient of one and no change by zero. The highest of the coefficients for any decade (0.16) was shown by the meat packing in the decade from 1919 to 1929, and the lowest by population in the decade from 1929 to 1939. Redistribution was less in the 1930's than in the 1920's, but not consistently lower than in each of the two previous decades. The redistribution over the period 1899 to 1939 was substantial, although less than the aggregate for the four decades included, thus reflecting the fact that some of the redistribution in later decades cancelled that in earlier decades.

TABLE 8.—*Coefficients of redistribution of population, and of wage earners in selected items, decennial census years 1899–1939*

	1899–1909	1909–19	1919–29	1929–39	1899–1939
Population	0.041	0.024	0.036	0.020	0.104
Total manufacturing	.038	.062	.060	.044	.149
Boot and shoe production	.069	.085	.152	.103	.265
Slaughtering and meat packing	.141	.091	.161	.115	.389

These measures of changes in location reflect only net changes. They do not, therefore, indicate all the shifts in industry. Alterations of locational patterns may occur because of the construction of new plants, abandonment of old ones, or differential rates of growth or decline among existing plants. It is necessary to record these changes separately to measure the gross rather than the net changes in redistribution.

[14] This coefficient is used by E. M. Hoover to measure population redistribution. See "Interstate Redistribution of Population from 1850 through 1940," *Journal of Economic History*, November 1941, pp. 199–205.

CHAPTER 6. MATERIALS

By Wilbert G. Fritz and Oscar L. Endler*

With respect to materials, the present-day economy is characterized by: (1) the large volume of commodities absorbed by ultimate consumption, by intervening processes of production, and by wastage; and (2) the marked extent to which the end products of industry differ in character and location from the raw materials. A study of the influence of materials on the location of industry must consider all stages of ultilization and the increasing concentration or dispersion at each level.

The output of one industry becomes the source of supply for a succeeding industry or group of industries. A sequence in type of material commonly found in the utilization of copper, steel, wool, cotton, and other important commodities is: crude raw material; refined raw material; one or more stages as a basic manufactured product; and one or more stages as a special purpose product, usually in combination with other types of materials. There appears to be some tendency toward geographic concentration of industries according to types of materials. Industry groupings based largely on types of materials, therefore, are helpful in developing a perspective, especially for those, such as steel, lumber, glass, cotton, and wheat, that tend to be the leading kinds of materials through many or most of the stages of production.

The degree of association of an industry with materials and the kind of material used are special problems for investigation. Geographic sources of materials have been discussed in chapters 1 and 2, which cover the effect of resources on the location of industry. It will be the major purpose of this chapter to explore materials from an industrial standpoint; that is, to show how materials are absorbed in industry, and how this process influences the locating of industry. Owing to the locational significance of manufacturing, discussion is centered around that activity.

Materials used in other activities also have some effects on location, but usually indirectly. Materials are the least represented in pure service industries, which, however, are relatively a small factor in the economy. The trend, no doubt, is toward the use of more materials in such activities. The volume of materials going into buildings, equipment, and supplies for education, health, and governmental services is now very large. The location of schools, post offices, and other service institutions, however, is more the result of social policy than of sources of material and their utilization. Accordingly, they are only of incidental interest here.

Historically, the more complex forms of utilization of materials have been added in large part to less complex forms, with the result that the influence of original sources of materials has in general become more remote. The increasing use of salvage material acts in the same direction. Volume loss, depreciation, and wastage of materials are determinants of the extent to which these forces may operate. An economy based mainly on transient goods has a simpler location problem than one based more largely on durable goods. In fact, considerable activity grows out of the effort to preserve nondurable goods, as in the canning and preserving industries. Painting, or otherwise protecting commodities, is also an effort to increase durability. This extension of life affects both the usefulness and the quantity of consumption of materials. A classification of materials based on durability, however, is less readily obtainable than the categories used in reports of the Census of Manufactures, and shows less in regard to stages of production, types of processes, combinations of materials, and ultimate use of the product.

Types of Materials

Materials as essentials for industry comprise raw materials for manufacture; semimanufactured materials for further processing; supplies necessary as aids in processing and containers for products; fuels and purchased electric energy which are needed to satisfy power, heat, and process requirements; and purchased contract work.

Raw materials consumed in manufacturing establishments may be delivered to the factory in the state in which they are found at various sources. Most of them, however, undergo some processing at or near their source before they are ready for smelting, manufacturing, or direct marketing to consumers. The term "raw materials" is broad enough to include substances which result from rudimentary processes applied at the source, such as the mine, the grain elevator, or the quarry. Products of mines especially are not always immediately suitable for manufacturing. They are often treated by various milling operations or beneficiating processes such as amalgamation, crushing, cyanidation, grinding, flotation, or sintering. In a way

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these operations to concentrate or improve the grade of ores may be termed manufacturing processes; but since they usually take place very close to the mines they are commonly considered part of mining activities. The smelting and refining of the concentrated ores then become the first step in the manufacturing cycle. Similar examples of initial rudimentary processing are found in agriculture such as the ginning of cotton, or the shelling of corn.

Semimanufactured materials, as broadly defined by the Bureau of the Census, are materials which either have been processed in a manufacturing establishment or have been subjected to certain processing operations generally carried on in factories. Some of these materials, for example, pig iron, are not ready for ultimate consumer use without further processing. Others, such as sugar, wire, sheet steel, and lumber, are used as finished products by certain consumers, but they are used also in great quantities as materials for the manufacture of other products. Often, it is difficult to draw a line between raw and semimanufactured materials, but the above definition, limiting raw materials to substances which have had at best only rudimentary processing, aids in the distinction.

Supplies and containers are often described as expense materials which do not become a part of the finished product, but which are indispensable to the various processing or marketing activities. Examples of such materials are lubricating oils, abrasives, machine parts, machine tools, furnace linings, and paint for maintenance. Containers needed by the manufacturer are frequently purchased completely manufactured and assembled for use.

Fuels and purchased power, such as coal, coke, fuel oils, gasoline, gas, and purchased electric energy, may be considered broadly as materials and, like the materials more directly related to the manufactured products, must be obtained or assembled by the manufacturer to carry on his work. In many establishments, such as those in the byproduct coke and carbon black industries, substances usually used for fuels are true raw materials for manufacture. In most establishments, however, fuels and purchased electric energy are materials for heat, power, and other process requirements but do not become part of the final product. For this reason their relations to location of industry are treated separately in chapter 7.

Origin of Manufacturing Materials

Since materials vary in geographic distribution, quality, and accessibility, the industrialist whose activities depend much on the location of one or more materials will consider their sources and future supply in locating his establishment. This consideration is especially necessary with regard to minerals, such as coal, iron ore, and copper ore, which are consumed in great quantities.

Discovery of new deposits, changes in mining methods, new techniques of ore reduction, and changes in prices may alter appreciably the economies of mineral supplies. New processes of mineral concentration and recovery in some instances have made profitable the reworking of "leavings" or "tailings" of earlier extractions and thus have added to the total available supply of materials. Notable examples of this are found in the history of the production of copper and anthracite. When the iron and steel industry first started, the low-grade iron ores in the Appalachian region were used along with the abundant coal deposits in the vicinity. At a later date rich iron ore deposits were discovered in the Lake Superior district which almost entirely displaced these sources of iron ore. It is possible that such discoveries of new deposits of minerals may completely alter the locational pattern of industries by creating more favorable competitive conditions in new areas. Following the Lake Superior ore discovery, however, the original iron works in the coal area managed to continue in their former location partly because they were close to sources of coal needed in great quantities, whereas the ore could be moved cheaply down the Great Lakes. If the rich iron ore reserves should become exhausted in the Lake Superior area, there would be more incentive to utilize the great deposits of low-grade iron ores in the Appalachian region. In fact, should more economical methods be discovered to reduce these ores, other iron and steel plants may be established in that region and may be successful in competing with mills using the Lake Superior ores. At present there are steel centers in eastern Pennsylvania and in Alabama where the Appalachian iron ores are suitable to afford competition with the Pittsburgh, Cleveland, and other districts using Lake Superior ores.

The availability of mineral resources is not flexible because their deposits are fixed in grade and in geographic position. Even when there is a choice between several fixed sources, there is always the fact to consider that mineral resources are wasting assets. The enterprising manufacturer who depends on a continued supply of raw materials may consider both domestic and international sources for his establishment, especially if there is a likelihood that domestic sources may soon be exhausted. If reduction of bulk is large, he will probably endeavor to concentrate and refine the minerals near sources of supply. Sometimes, as in the case of iron ores having a rich metal content, it is more efficient to move the ores to the source of energy for

refining, particularly if that source is close to the markets for the manufactured products. Thus markets and sources of coal may influence the location of blast furnaces more than the deposits of iron ore.

Compared to the large list of finished products which result from manufacture, the number of raw materials is small. Their origins also are relatively few in number, consisting almost wholly of five extractive industry groups, classed as follows: agriculture and animal husbandry; mining and quarrying; logging and forestry; hunting and trapping; and fishing. There are no very recent statistics available to show the relative importance of these various extractive industries in supplying raw materials to manufacturers. The Bureau of the Census, however, has estimated the value of the products contributed to manufacturing industries in 1929 by each of the extractive sources (table 1). Because the relative importance of the value of raw materials derived from each of the extractive industries has probably changed little since 1929, the data for that year are still a useful indication of the relationship of raw materials to manufacturing. In terms of cost, agriculture supplied 67.4 percent of the raw materials (not including fuels and purchased power) used in manufacturing in 1929; mining and quarrying supplied 27.6 percent; logging and forestry, 3.8 percent; and hunting, fishing, and trapping combined, only 1.3 percent (table 1). The volume of manufacture associated with the materials, however, shows a far different distribution. One-half of the total value added by manufacturing was for industries consuming materials (excluding fuels, which would have increased the proportion) obtained from mines and quarries. The greatest relative increase in value added by manufacture, however, was for industries consuming materials of the logging and forestry sources, the ratio to cost of materials being 13 to 1. The corresponding ratio was 4.5 to 1 for mining and quarrying materials, whereas those for materials of agriculture and of hunting, trapping, and fishing were each approximately 1 to 1.

Eighty-three percent of the materials used in American manufacturing were of domestic origin. Among the foreign materials used, those of agricultural origin predominated, the proportion being 81 percent of the total for foreign materials.

These comparisons of raw materials are all in terms of values. No doubt the locational pull of materials is partly related to such values owing to positively correlated outlays for handling, transportation, insurance, and other requirements. This is particularly likely since the cost data are for materials delivered to the plant and therefore include outlays for getting the materials from the source to the consuming plant.

TABLE 1.—*Estimated distribution among industry sources (domestic and foreign) of raw materials consumed in manufacturing in the United States, and the probable value added to materials by manufacture, 1929*

[Values in millions of dollars]

Industry source	All raw materials for United States manufactures		Raw materials of domestic origin		Raw materials of foreign origin		Probable value added by manufacture	
	Value[1]	Percent of total	Value	Percent of total	Value	Percent of total	Value	Percent of total
Total, all sources	12,676	100.0	10,472	100.0	2,204	100.0	31,885	100.0
Agriculture	8,541	67.4	6,763	64.6	1,778	80.7	9,508	29.8
Mining and quarrying	3,494	27.6	3,279	31.3	215	9.8	15,929	50.0
Logging and forestry	477	3.8	390	3.7	87	3.9	6,277	19.7
Hunting, fishing, and trapping	164	1.3	40	.4	124	5.6	171	.5

Source: Cost data from Tracy E. Thompson, *Materials Used in Manufactures: 1929*, Bureau of the Census, 1933, p. 4. Value added by manufacture data estimated from Charles A. Bliss, *The Structure of Manufacturing Production*, New York, National Bureau of Economic Research, 1939, pp. 46–53; and *Census of Manufactures, 1929*, Bureau of the Census.

[1] Does not include the following basic materials: Scrap materials amounting to $471,300,000, or 3.7 percent of the total cost of $12,676,000,000 listed above; unmanufactured fuels amounting to $822,685,490, or 6.5 percent; and purchased electric energy (generated by fuel and water power) amounting to $475,633,877, or 3.8 percent.

Data on the bulk, or physical quantity, of materials consumed by manufacturing unfortunately are not available for all types of plants. In chapter I it was indicated that mines and quarries supplied eight times as much tonnage of materials for the economy as agriculture and about six times as much as forestry, and that other sources supplied an almost negligible proportion. Large shares of many materials, such as dairy products, fruits, nuts, vegetables, eggs, fish, gold, silver, coal, petroleum, natural gas, sand, gravel, stone, and fuel wood, counted into the calculations shown on page 10, do not enter into the manufactured product because they are consumed directly. In general, the proportion so used is somewhat smaller for minerals and for forestry products than for agricultural products. There are, of course, numerous factors besides cost and weight connected with materials that influence the location of manufacturing plants. Perishability of fruits and vegetables, for example, forces the location of canning and preserving close to the source of supply, and the marked loss of bulk of copper, lead, and zinc ores in the smelting process has a similar effect.

Relation of Cost of Materials to Value of Manufactured Products

During 1939 the products of manufacturing industries according to returns made by manufacturers to the Bureau of the Census were valued at approximately $56,828,800,000. To manufacture the various products, the establishments used materials, supplies, fuels, purchased electric energy, and contract work aggregating approximately $32,118,200,000. These costs were 56.5 percent of the value of the products.

The gross figures for value of products and for the cost of all kinds of materials include a considerable amount of duplication because establishments in a given industry often use as materials the finished or semifinished products of other establishments in the same or another industry. In 1929 the Bureau of the Census calculated a figure to represent the net value of products manufactured; that is, a figure which excluded duplications. The net value of product was approximately two-thirds of the gross value. Similar computations were made by the Bureau of Foreign and Domestic Commerce for each census year from 1899 through 1929.[1] In this series the net value of products varied from 60.2 to 68.7 percent of the gross value; the low proportions were obtained for the 1919 and 1921 census years. Calculations of the same type made by the Bureau of the Census for the costs of all kinds of materials used in manufacturing during 1929, showed that the net value of raw materials was approximately one-third of the gross value of all materials reported.[2]

After determining the net value of products and net cost of materials in manufacturing for 1929, the Bureau of the Census could then allocate the net value of manufactured products among the component cost items. Such statistics, presented in Table 2, show that the cost of raw materials is one of the most important expense items in manufacturing.

TABLE 2.—*Distribution of net value and of gross value of manufactured products among component cost items, 1929*

Cost item	Percent of total net value [1]	Percent of total gross value
Total value	100.0	100.0
Salaries	8.8	6.0
Wages	24.4	16.5
Cost of raw materials and imported semimanufactures	30.4	20.6
Cost of domestic semimanufactures	0	31.5
Cost of unmanufactured fuels	2.7	1.8
Cost of manufactured fuels [2]	0	.8
Other expenses, interest, and profits	33.7	22.8

Source: Tracy E. Thompson, *Materials Used in Manufactures: 1929*, Bureau of the Census.

[1] The net value of products was determined by eliminating duplicating of products of one industry used as materials by another.
[2] Principally derived products of petroleum and coal.

Regional Variation of the Cost of Materials

The ratio of cost of materials (broadly defined to include fuel and other related items) to value of products shows an inverse variation geographically with the degree of concentration of manufacturing. The New England area shows the lowest ratio of cost of materials to values of products, the Middle Atlantic area the second lowest, and the East North Central area (Great Lakes States) the third lowest (table 3). These three areas constitute the major manufacturing region of the country.

There is less geographic concentration of cost of materials than of value of products or value added by manufacture. In other words, the areas that specialize most in manufacturing tend to add the greatest proportion of value to the product. The location of manufacturing in such areas is less determined by materials than it is in areas with less concentration of manufacturing. Furthermore, industry there consumes a proportionately greater share of semimanufactures compared to raw materials.

The unduplicated outlays on materials in the principal manufacturing states is relatively much lower than is suggested by the above data on all materials, for in those States is found the greatest multiple counting of materials in the census tabulations. States in the manufacturing belt, which use large quantities of semimanufactures, have a greater spread between the cost of raw materials and the value of finished products than do states outside this area of intensive manufacturing. Declining relative cost of materials, and very likely also declining orientation of location about materials, are associated with increasing concentration of industry.

Probable Influence of Materials on Location of Industry

Sufficient has been said about materials to suggest a number of generalizations concerning their influences on location of industry. Other things being equal, their locational pull is likely to vary according to:

1. The proportion of total expenses which they occasion in manufacture.

2. The combination of materials in the manufacturing process, that is, the importance of one commodity, or at most, two or three commodities, as opposed to a variety of materials.

3. The necessity of processing materials in sequence or in fixed successive stages of production.

4. The degree of specialization of materials required in particular industries.

5. The degree of impracticability of using substitutes.

6. The degree of perishability, and the difficulty of protecting materials against deterioration.

7. The loss in weight or bulk which accompanies the processing of materials; and as a corollary:

8. The expense or effort required for transporting materials compared to that for the products made from them.

[1] *Commerce Yearbook, 1932*, United States Department of Commerce, p. 92.
[2] Tracy E. Thompson, *Materials Used in Manufactures, 1929*, Bureau of the Census, 1933.

TABLE 3.—*Amount and percent distribution of the cost of materials and of the value of products in raw-material-consuming and in semimanufactured-material-consuming industry groups for selected geographic areas in the United States, 1939*

Geographic area	Cost of materials in manufacturing industry groups [1]										
	Millions of dollars			Percent of United States total			Percent of total in each industry group		Ratio of cost of materials to value of products		
	All industries	Raw material consumers [2]	Semi-manufacturing consumers [2]	All industries	Raw material consumers	Semi-manufacturing consumers	Raw material consumers	Semi-manufacturing consumers	All industries	Raw material consumers	Semi-manufacturing consumers
United States	32,160	11,682	20,478	100.0	100.0	100.0	36.3	63.7	56.6	70.8	50.8
14 industrial States [3]	20,925	5,215	15,710	65.1	44.6	76.7	24.9	75.1	54.4	68.8	50.8
Remainder of Nation	11,235	6,476	4,759	34.9	55.4	23.2	57.6	42.4	61.2	72.6	50.4
New England	2,463	676	1,787	7.7	5.8	8.7	27.4	72.6	50.3	57.7	48.0
Middle Atlantic	8,684	2,175	6,509	27.0	18.6	31.8	25.0	75.0	54.1	68.8	50.6
East North Central	9,778	2,364	7,414	30.4	20.3	36.2	24.2	75.8	55.7	72.7	51.8

Geographic area	Value of products in manufacturing industry groups [1]										
	Millions of dollars			Percent of United States total			Percent of total in each industry group		Ratio of value added by manufacture to value of products		
	All industries	Raw material consumers [2]	Semi-manufacturing consumers [2]	All industries	Raw material consumers	Semi-manufacturing consumers	Raw material consumers	Semi-manufacturing consumers	All industries	Raw material consumers	Semi-manufacturing consumers
United States	56,843	16,494	40,349	100.0	100.0	100.0	29.0	71.0	43.4	29.2	49.2
14 industrial States [3]	38,491	7,585	30,906	67.7	46.0	76.6	19.7	80.3	45.6	31.2	49.2
Remainder of Nation	18,352	8,912	9,440	32.3	54.0	23.4	48.6	51.4	38.8	27.3	49.6
New England	4,892	1,171	3,721	8.6	7.1	9.2	23.9	76.1	49.7	42.3	52.0
Middle Atlantic	16,039	3,163	12,876	28.2	19.2	31.9	19.7	80.3	45.9	31.2	49.4
East North Central	17,560	3,251	14,309	30.9	19.7	35.5	18.5	81.5	44.3	27.3	48.2

Source of value figures: *Census of Manufactures, 1939.*

[1] The manufacturing industries have been divided into raw-material-consuming and semimanufactured-material-consuming groups according to the predominant type of materials used in each industry. An industry was designated as a raw-material consumer if more than 50 percent of its expenditures for materials were for raw materials. Further description of the groups and a listing of the raw-material-consuming industries are found on pp. 133-136.

[2] The amounts of the cost of materials and of the value of products for the raw-material-consuming and for the semimanufactured-material-consuming industry groups are partially estimated because statistics for some industries in each State were not published separately by the Bureau of the Census in order not to reveal operations of individual establishments The amounts included in the "all other industries" category was allocated, for each State, between the raw-material-consuming and the semimanufactured-material-consuming groups in proportion to the given statistics.

[3] The 14 industrial States comprise the New England States: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; the Middle Atlantic States: New Jersey, New York and Pennsylvania; and the East North Central States: Illinois, Indiana, Ohio, Michigan, and Wisconsin.

9. The extent to which materials are concentrated commercially in certain areas, compared to the distribution of effective markets for their products.

10. The variety of uses which may be made of the materials and their products.

Examination shows that most of these qualities are more likely to attach to raw materials than to semimanufactured goods. Which of these factors controls when they are in conflict (as often happens) depends on a variety of circumstances. When they reinforce each other, their weight becomes still more compelling.

Data for selected industries will be examined in the following paragraphs for confirmation, or refutation, of the foregoing principles.

Cost of Materials for Industry Groups

Considering gross values of products and materials, which include the amounts spent for semimanufactured materials at various stages, the cash outlay for materials of all kinds is the largest single item of cost represented in the gross value of products for nearly all industry groups. This fact is shown in Table 4 which gives the percent of the cost of materials to the value of products for manufacturing industry groups in 1939. The proportionate costs of materials are of varying importance. Industry groups in which the cost of materials is of greatest significance are those for food and kindred products, tobacco manufactures, products of petroleum and coal, nonferrous metals and their products, and automobile and automobile equipment industries. In these groups the cost of materials to manufacturers represents more than 65 percent of the gross value of their products. Some of the individual industries within these groups show this proportion to be even higher. Examples are oven coke and coke-oven byproducts, petroleum refining, primary smelting and refining of nonferrous metals, cigarettes, canned and dried fruits and vegetables, and cane-sugar refining. It will be seen later that it is among such industries that there is the greatest tendency to locate processing factories near the sources of raw materials.

Table 4 also shows that printing and publishing, stone, clay, and glass, machinery, electrical machinery, and miscellaneous industries use materials which constitute a relatively low proportion of their value of products. Typical examples of individual establishments in this category are in the industries for photoengraving; photographic apparatus, materials, and

projection equipment; printing and publishing of periodicals; costume jewelry; electrical appliances; electrical measuring instruments; flat glass; glass containers; industrial machinery; machine tools; pottery; statuary and art goods; and machine and hand typesetting. In such industries intricate hand or machine workmanship on relatively inexpensive materials frequently accounts for the wide margin between cost of materials and value of products. It should be expected that establishments in these industries may locate with little regard to sources of materials, for other factors, such as markets and supply of skilled labor are more important.

By far the greatest number of industries use materials costing between 45 and 65 percent of the value of products manufactured. Industries included in this typical range generally use a wide variety of materials, chiefly semimanufactured products purchased from other firms, and a large number manufacture a long line of related products which are sold at relatively high values.

Relation of Cost of Materials to Other Cost Items for Selected Industries

Additional information confirming the importance of expenditures for materials is available from the industrial corporation reports of the Federal Trade Commissions. Figure 56[3] shows the proportion of total sales distirbuted among various operating expenses and profits for selected corporations. The direct materials costs are the largest expense items represented in the total sales for nearly all of the selected corporations. Table 5 shows the percent distribution of total costs into its component production, trading, and administrative costs for selected manufacturing corporations in 1939.

The statistics in this table were reported by the Federal Trade Commission for the principal corporations in each of the selected industries. The cost of direct materials is the largest expense item represented in the total costs for nearly all of the selected corporations. There are, however, several significant exceptions. Corporations in the firearms and ammunition; electrical machinery; machine tool and other metal working machinery, accessories, and machinists' precision tools; saws, files, and hand tools; and office and store machines industries reported greater expenses for wages and salaries. These industries are engaged in very skilled manufacturing processing of relatively inexpensive materials. Thus, labor costs and even selling expenses should be expected to be large items for their high valued products. In the table the cost of indirect materials such as fuels, purchased power, and supplies probably form the greatest proportion of the item, "other production costs and expenses." Corporations in the printing and publishing of books and in the perfumes, cosmetics, and other toilet preparations industries reported greater expenses for selling and advertising activities. In these two industries processing is done on materials with relatively little labor cost to manufacture products that are of high value compared to their basic materials. Corporations in the malt liquors and in the cigars, cigarettes, chewing and smoking tobacco, and snuff industries reported greater expenses for general office and other costs. In these cases taxes are the most important item.

Note that of all the exceptions where the cost of direct materials is not the largest expense item, only the tobacco manufacturing industries are designated in the table as raw-material-consuming industries. Generally it is to be expected that industries performing only one stage of manufacture should show a higher ratio of cost of materials and that industries carrying materials through several stages should show a lower ratio. In succeeding paragraphs a finer analysis of all materials, both direct and indirect, is used as a basis for classifying industries as raw-material-consuming and as semi-manufactured-material-consuming industries.

TABLE 4.—*Value of products, cost of all kinds of materials, and ratio of cost of materials to value of products, by industry groups, 1939*

[Millions of dollars]

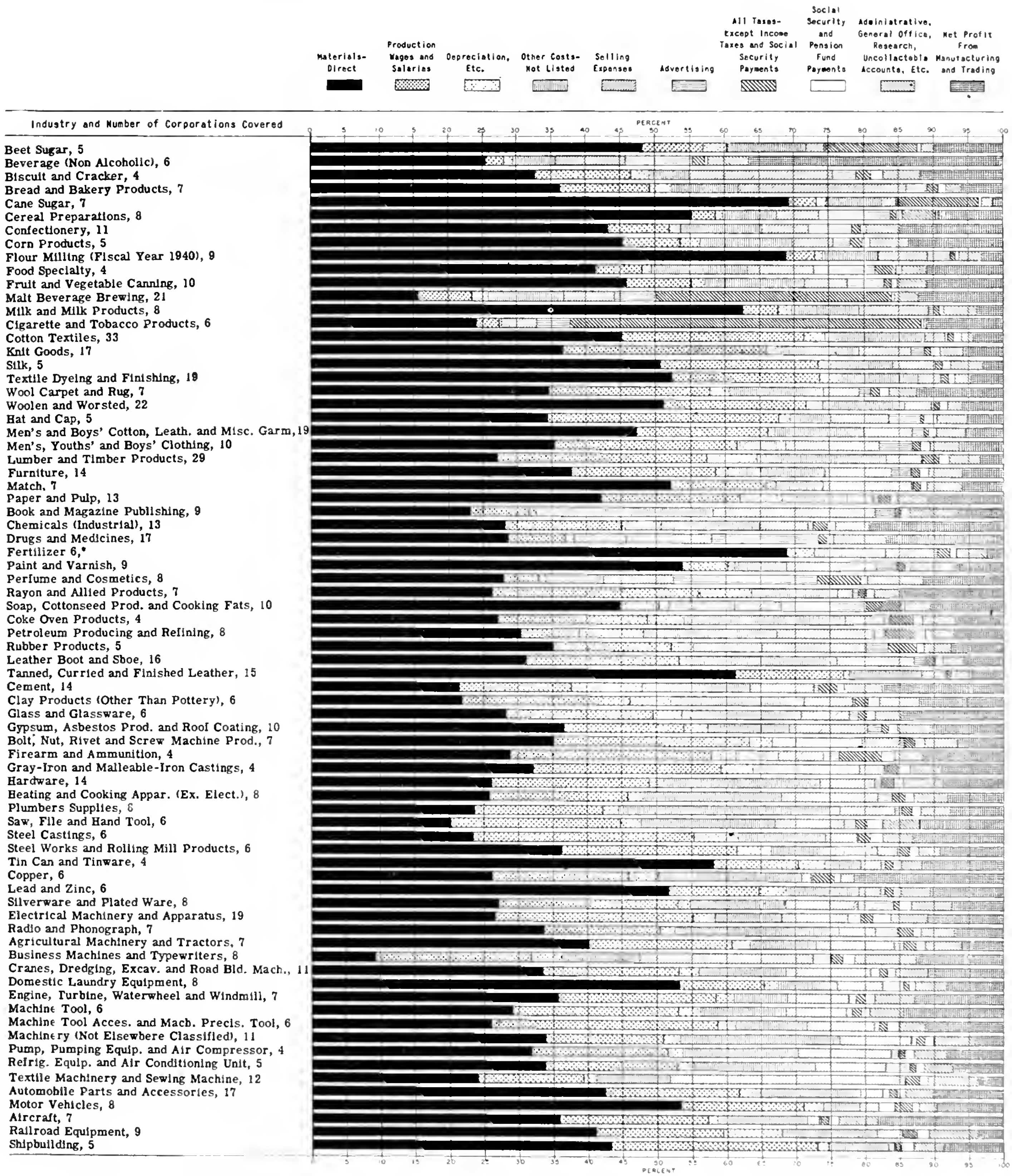
Industry group	Value of products	Cost of materials, supplies, fuels, purchased electric energy, and contract work	Percent cost of materials is of value of products
All industry groups	56, 843	[1] 32, 160	56. 6
Food and kindred products	10, 618	7, 062	66. 5
Tobacco manufactures	1, 322	972	73. 5
Textile-mill products and other fiber manufactures	3, 931	2, 109	53. 7
Apparel and other finished products made from fabrics and similar materials	3, 325	1, 944	58. 5
Lumber and timber basic products	1, 122	504	44. 9
Furniture and finished lumber products	1, 268	641	50. 6
Paper and allied products	2, 020	1, 150	56. 9
Printing, publishing, and allied industries	2, 578	812	31. 5
Chemicals and allied products	3, 734	1, 854	49. 7
Products of petroleum and coal	2, 954	2, 279	77. 1
Rubber products	902	496	55. 0
Leather and leather products	1, 389	806	58. 0
Stone, clay, and glass products	1, 440	529	36. 7
Iron and steel and their products, except machinery	6, 592	3, 636	55. 2
Nonferrous metals and their products	2, 573	1, 749	68. 0
Electrical machinery	1, 727	727	42. 1
Machinery, except electrical	3, 254	1, 285	39. 5
Automobiles and automobile equipment	4, 048	2, 725	67. 3
Transportation equipment except automobiles	883	411	46. 6
Miscellaneous industries	1, 163	469	40. 3

Source of amounts: *Census of Manufactures, 1939.*

[1] Consists of $30,255,000,000 for materials and supplies, $850,000,000 for fuels' $465,000,000 for purchased electric energy, and $589,000,000 for commission and contract work.

[3] From Federal Trade Commission, *Summary of Industrial Corporation Reports, 1941*, p. 7.

PERCENT DISTRIBUTION OF TOTAL SALES INTO COMPONENT OPERATING EXPENSES AND PROFITS FOR SELECTED MANUFACTURING CORPORATIONS, 1939



*For Fertilizer Corporations, the Solid Bar Represents Materials-Direct and Production Wages and Salaries Combined

FIGURE 56

TABLE 5.—*Ratio of various production, trading, and administrative costs to total costs for selected industries, 1939*

[Industries ranked according to cost of direct materials in raw-material-consuming and in semimanufactured-material-consuming groups]

Industry [1]	Coverage		Production costs (percent)			Trading and administrative costs (percent)		
	Number of corporations	Percent sales are of all industry products	Materials cost—direct	Wages and salaries	Other production expenses	Finished goods purchased for resale	Selling and advertising expenses	General office and other expenses
Raw-material-consuming industry								
1. Flour and other grain-mill products	9	48.5	68.9	5.0	3.1	5.5	11.5	6.0
2. Milk and milk products [2]	8	15.9	65.2	5.3	8.4	1.5	11.0	8.6
3. Leather: tanned, curried, and finished	15	31.7	64.4	16.3	10.8	.1	3.8	4.6
4. Cereal preparations and rice cleaning and polishing	8	(3)	61.2	3.6	8.5	0	18.3	8.4
5. Primary smelting and refining, lead and zinc	6	76.5	57.9	14.6	5.3	5.7	4.3	12.2
6. Woolen and worsted manufactures	22	35.0	54.6	21.8	12.6	(4)	4.3	6.7
7. Corn sirup, corn sugar, corn oil and starch	5	92.1	52.6	9.7	14.2	1.4	9.9	12.2
8. Silk manufactures	5	31.7	52.3	23.5	8.3	0.7	6.4	8.8
9. Canned and dried fruits and vegetables (including canned soup)	10	45.0	51.9	10.4	6.1	10.0	13.1	8.5
10. Soap and glycerine; cottonseed oil, cake, meal, and linters; cooking and other edible fats and oils [5]	10	70.0	50.3	6.2	8.4	2.0	21.4	11.7
11. Paper and pulp	13	23.5	47.3	22.5	10.4	.2	5.3	14.3
12. Cotton manufactures	33	35.6	47.2	27.6	12.8	2.1	3.5	6.8
13. Food specialties [6]	4	74.7	46.8	7.6	10.2	5.3	20.9	9.2
14. Primary smelting and refining, copper	6	65.0	33.4	25.0	23.7	2.6	2.0	13.3
15. Silverware and plated ware	8	67.0	29.4	28.0	5.9	9.1	17.1	10.5
16. Oven coke and coke-oven byproducts	4	33.5	29.3	23.2	9.1	15.9	6.8	15.7
17. Cigars, cigarettes, chewing and smoking tobacco, and snuff	6	79.2	27.1	3.6	2.3	.2	8.4	58.4
18. Cement	14	41.0	26.0	19.7	17.2	1.5	12.0	23.6
Semimanufactured-material-consuming industry								
1. Cane sugar refining	7	71.5	70.4	4.4	5.8	2.2	2.1	15.1
2. Tin cans and other tinware [5]	4	81.0	66.1	14.1	5.4	.6	3.9	9.9
3. Fertilizers	6	41.1	60.5	10.6	8.3	2.2	7.9	10.5
4. Motor vehicles, etc.	8	73.6	59.2	19.5	5.5	.3	5.8	9.7
5. Paints, varnishes and lacquers	9	36.0	58.1	7.0	7.1	.8	17.4	9.6
6. Matches	7	(3)	55.4	14.9	7.1	.4	13.7	8.5
7. Dyeing and finishing cotton, rayon, silk and linen textiles	19	34.0	55.0	22.3	10.1	1.6	3.6	7.4
8. Men's and boys' furnishings, work and sport garments	19	18.1	50.1	20.2	4.9	8.7	9.5	6.6
9. Shipbuilding and ship repairing	5	38.5	47.6	32.4	9.5	0	1.0	9.5
10. Motor vehicle bodies, parts, and accessories and automobile trailers	17	11.4	47.4	21.3	15.6	.4	4.8	10.5
11. Aircraft and parts, including aircraft engines	7	65.0	44.0	25.9	12.8	3.0	2.5	11.8
12. Agricultural machinery including tractors	7	(3)	43.2	22.1	7.5	2.6	13.7	10.9
13. Railroad equipment	9	62.7	42.8	19.0	12.3	2.0	3.7	20.2
14. Steam engines, turbines, water wheels, and internal combustion engines	7	33.3	41.1	26.1	8.7	.2	11.7	12.2
15. Gypsum and asbestos products and roof coating (except paint)	10	(3)	41.0	19.3	9.0	4.1	15.1	11.5
16. Furniture [7]	14	14.0	40.3	22.1	12.8	1.9	13.2	9.7
17. Steel works and rolling mills	5	18.6	40.2	27.8	13.0	4.0	3.3	11.7
18. Nonalcoholic beverages	6	35.9	40.1	4.6	5.2	4.3	31.5	14.3
19. Carpets and rugs, wool (other than rag)	7	55.0	39.5	26.6	14.4	1.2	7.7	10.6
20. Knit goods	17	17.7	38.8	31.2	4.9	7.1	9.9	8.1
21. Bread and bakery products	7	16.7	38.7	13.8	8.2	1.9	28.8	8.6
22. Rubber products	5	61 2	38.2	18.6	3.8	6.8	19.9	12.7
23. Construction and similar machinery (except mining and oil-field machinery and tools)	11	50.2	37.9	22.4	8.6	5.5	15.4	10.2
24. Men's and boys' tailored clothing	10	14.3	37.8	28.0	5.0	2.3	19.7	7.2
25. Bolts, nuts, washers, and rivets—made in plants not operated in connection with rolling mills	7	41.5	37.5	30.3	12.2	1.8	6.6	11.6
26. Refrigeration machinery and equipment and complete air-conditioning units, including domestic refrigerators	5	19.6	36.7	20.6	9.5	9.7	14.8	8.7
27. Radios, radio tubes, and phonographs	7	75.5	36.4	18.0	22.7	2.9	9.3	10.7
28. Hats, felt and straw, except millinery	5	38.0	36.4	35.2	4.7	1.6	13.6	8.5
29. Machinery [5, 8]	11	15.2	35.5	17.9	11.3	12.7	11.9	10.7
30. Gray-iron, semisteel, and malleable iron castings	4	19.0	35.3	29.7	15.9	.9	4.4	13.8
31. Chemicals [5]	13	(3)	35.1	20.8	8.0	9.4	9.4	17.3
32. Pumping equipment and air compressors	4	25.0	34.7	21.5	9.5	8.5	15.9	9.9
33. Drugs and medicine (including drug grinding)	17	58.9	34.5	10.0	7.7	1.6	32.9	13.3
34. Machine tools	6	23.6	34.0	28.0	14.6	0	11.3	12.1
35. Footwear, except rubber	16	45.3	33.3	23.4	8.2	14.7	13.9	6.5
36. Flat glass and pressed or blown glassware	6	73.1	33.2	24.8	17.0	3.3	9.5	12.2
37. Firearms and ammunition	4	65.0	32.8	33.0	6.2	.7	10.1	17.2
38. Perfumes, cosmetics, and other toilet preparations	8	15.3	31.6	5.9	6.4	3.2	34.7	18.2
39. Electrical machinery	19	55.6	29.9	32.0	5.2	5.6	13.0	14.3
40. Machine-tool and other metal-working machinery, accessories, metal-cutting and shaping tools, and machinists' precision tools	6	30.7	29.5	36.8	7.5	4.2	11.8	10.2

Source: Compiled from the *Industrial Corporation Reports* of the Federal Trade Commission.

[1] The industry classification used by the Federal Trade Commission is in accordance with the Standard Industrial Classification prepared by the Central Statistical Board. Since this classification is comparable with that used by the Bureau of the Census, the industry titles in this table are those designated by the *Census of Manufactures, 1939* except in the few cases noted.

[2] The milk and milk products industry may include one or more of the following industries designated by the Bureau of the Census: creamery butter, cheese, condensed and evaporated milk, ice cream and ices, special dairy products.

[3] The total amount of sales for the covered corporations exceeded the value of products for the entire industry as reported by the Bureau of the Census. The explanation for this is that data for the Federal Trade Commission Industrial Reports pertain to the entire operations of corporations, while data for the Bureau of the Census are by establishments and sometimes the operations of some plants of a given corporation have undoubtedly been reported in different industry classifications. Thus such discrepancies occur in those instances in which the corporation operates a number of plants manufacturing different products and also in instances where the corporation operates plants in foreign areas. In the latter case the Bureau of the Census does not receive reports from foreign establishments of domestic corporations.

[4] Less than 0.05 percent.

[5] Not elsewhere classified.

[6] The food specialities industry may include one or more of the following industries designated by the Bureau of the Census: Baking powder, yeast, and other leavening compounds; chocolate and cocoa products; salad dressings; quick-frozen foods; food preparations (n. e. c.).

[7] The furniture industry includes the manufacture of household, office, public building, and professional furniture.

[8] The machinery, n. e. c., industry may include one or more of the following industries designated by the Bureau of the Census: Construction and similar machinery; oil-field machinery and tools; mining machinery and equipment; food-products machinery; woodworking machinery; paper-mill, pulp-mill, and paper-products machinery; special industry machinery, not elsewhere classified; elevators, escalators, and conveyors; cars and trucks, industrial and mining; blowers, exhaust and ventilating fans; stokers, mechanical, domestic and industrial machinery, not elsewhere classified; vending, amusement, and other coin-operated machines; commercial laundry, dry-cleaning, and pressing machines; metal-working machinery and equipment, not elsewhere classified.

TABLE 5.—*Ratio of various production, trading, and administrative costs to total costs for selected industries, 1939*—Continued

Industry [1]	Coverage		Production costs (percent)			Trading and administrative costs (percent)		
	Number of corporations	Percent sales are of all industry products	Materials cost—direct	Wages and salaries	Other production expenses	Finished goods purchased for resale	Selling and advertising expenses	General office and other expenses
41. Hardware [5]	14	57 0	28.6	25.0	14.8	9.8	9.9	11.9
42. Heating and cooking apparatus (except electric) [5]	8	27.2	28.2	21.9	10.0	11.5	17.5	10.9
43. Lumber and timber products	29	18.5	28.1	31.4	19.3	8.9	5.5	15.8
44. Textile machinery and sewing machines, domestic & industrial	12	(3)	26.0	16.4	5.5	5.8	36.7	9.6
45. Vitreous-china plumbing fixtures, enameled-iron sanitary ware, and other plumbers supplies, except pipe	8	(3)	25.7	20.3	10.2	24.3	9.7	9 8
46. Printing and publishing books and periodicals	9	25.0	25.0	9.1	23.0	4.3	28.3	10.3
47. Saws, files, and tools, (except edge tools and machine tools)	6	28.0	22.9	28.4	20.7	1.5	13.0	13.5
48. Malt liquors	21	44 4	17.8	9.0	12.4	(4)	15.3	45.5
49. Office and store machines [5]	8	(3)	10.8	25.8	11.1	1.8	31.7	18.8

See footnotes on preceding page.

Raw-Material-Consuming vs. Semimanufactured-Material-Consuming Industries

The casual impression is that almost every industry uses large amounts of raw materials. This is not true even if unmanufactured fuels such as coal and natural gas were considered as raw materials for manufacture. There are many individual manufacturing establishments, particularly those in printing and publishing, leather products, rubber products, and transportation equipment industries, that use no raw materials but only semimanufactured or semifinished materials. If unmanufactured fuels are not counted as raw materials for manufacture, many more industries may be classified as using no raw materials.

When considering sources of raw materials for industry and their influence on the location of manufacturing establishments, it is pertinent to determine the extent to which industries may be concerned with the different types of materials.

Obviously, all manufacturing industries are concerned with some type of materials. Service industries and manufacturing industries using predominantly semimanufactured materials are affected only indirectly or not at all by raw materials. In these cases the industrial establishment locates primarily for reasons other than those concerned with materials, because producers of semimanufactured materials are usually very versatile and adept at making their products available over wide areas.[4] There are, however, some exceptions. For example, steel castings establishments tend to locate near iron and steel works from which they derive their supplies of semimanufactured iron and steel. In this example and for many other uses of semimanufactured materials, the important fact is that, if there is some relation between the location and the raw materials used, it is an indirect relation because the user of the semimanufactures will tend to locate near the industry which processes the raw materials. The location problems in connection with materials are primarily those concerned with raw materials.

Statistics of material costs, unfortunately, do not show the value of raw materials used in each industry. The Bureau of the Census published an analytical study of materials in industry as reported in 1929.[5] In that study manufacturing industries were divided into two groups according to the predominant character of the materials used; namely, raw-material-consuming industries and semimanufactured-material-consuming industries.

This is the most recent study of the type available. The information is still useful, for the basic character of industries with respect to use of raw and semimanufactured materials has not changed radically since 1929. It is true that there have been changes in industry since 1929, but the definitions and classifications of industries for the Census of Manufactures for 1929 and for 1939 show fundamentally the same industrial structure from a materials and products point of view. Some of the findings of the 1929 study of materials used in manufactures are, therefore, very appropriate for this analysis of materials and location. Less than 21 percent of the industries as reported by the Bureau of the Census for 1929 used over 83 percent of the raw materials consumed in manufacturing. Of the 326 industries reported, only 68 were considered as predominantly raw-material-consuming industries, and the remaining 258 were classified as semimanufactured-material-consuming industries. The raw-material-consuming industries were defined as those in which more than 50 percent of their expenditures for materials were for raw materials. The 68 industries classified by industry groups were as follows:

Food and kindred products:

1. Butter.
2. Canning and preserving: Fish, crabs, shrimps, oysters, and clams.

[4] See chapter 18. *Price Policies*, pp. 302-316.

[5] Tracy E. Thompson, *op. cit.*

3. Canning and preserving: Fruits and vegetables; pickles, jellies, preserves, and sauces.
4. Cereal preparations.
5. Cheese.
6. Chocolate, cocoa products, except candy.
7. Coffee and spice, roasting and grinding.
8. Condensed and evaporated milk.
9. Corn sirup, corn starch, corn oil, and starch.
10. Feeds, prepared for animals and fowls.
11. Flour and other grain-mill products.
12. Ice cream.
13. Malt.
14. Meat packing, wholesale.
15. Peanuts, walnuts, and other nuts, processed or shelled.
16. Poultry killing, dressing, and packing, wholesale.
17. Rice cleaning and polishing.
18. Sugar, beet.
19. Sugar, cane, except products of refineries.

Textiles and their products:

20. Cordage and twine.
21. Cotton goods.
22. Felt goods, wool, hair, or jute.
23. Haircloth.
24. Hat and cap materials, men's.
25. Jute goods.
26. Linen goods.
27. Mats and matting, grass and coir.
28. Silk and rayon manufactures.
29. Upholstering materials.
30. Woolen goods.
31. Baskets and rattan and willow ware, except furniture.
32. Cork products.
33. Excelsior.
34. Turpentine and rosin.

Paper and allied products:

35. Pulp (wood and other fiber).

Chemicals and allied products:

36. Bone black, carbon black, and lampblack.
37. Grease and tallow, not including lubricating greases.
38. Liquors, vinous.
39. Cottonseed oil, cake, and meal.
40. Linseed oil, cake, and meal.
41. Essential oils.
42. Vegetable oils, not elsewhere classified.
43. Salt.
44. Wood distillation, charcoal manufacture.

Products of petroleum and coal:

45. Coke, not including gas-house coke.
46. Gas, manufactured, illuminating and heating.
47. Petroleum refining.

Leather and its manufactures:

48. Leather—tanned, curried, and finished.

Stone, clay, and glass products:

49. Cement.
50. Clay products (other than pottery) and nonclay refractories.
51. Graphite, ground and refined.
52. Lime.
53. Marble, granite, slate, and other stone products.
54. Minerals and earths, ground or otherwise treated.
55. Pottery, including porcelain ware.
56. Wall plaster, wall board, insulating board, and floor composition.

Iron and steel and their products except machinery:

57. Iron and steel, blast furnaces.

Nonferrous metals and their products:

58. Silversmithing and silverware.
59. Smelting and refining, metals (other than gold, silver, or platinum), not from ore.
60. Smelting and refining, zinc.

Miscellaneous industries:

61. Brooms.
62. Cigars and cigarettes.
63. Foundry supplies.
64. Fur goods.
65. Hair work.
66. Ivory, shell, and bone work, except buttons, combs, or hairpins.
67. Lapidary work.
68. Tobacco—chewing and smoking, and snuff.

Establishments classified among these 68 industries are likely to feel the pull toward sources of raw materials. Even though these industries were designated as the principal consumers of raw materials because more than half their expenditures for materials were for raw materials, they do not include all the industries that consume large amounts of raw materials. Important raw-material consumers not included among the 68 industries are glass factories, sawmills, veneer mills, and cooperage stock mills. One reason that some of these industries are not on the above list is that in addition to raw materials, they consume large amounts of semi-manufactures with the result that the cost of raw materials constitutes less than half of the

total expenditures for materials.[6] The distribution of the cost of materials among raw materials and semimanufactures in any industry depends to some extent on the plan of industry classification; the Bureau of the Census generally follows the practice of industry in distributing processes among specialized lines of manufacture.[7]

The significant feature of the 68 raw-material-consuming industries is not only that they spend large sums of money for raw materials compared to semimanufactures, but also that they consume almost all the raw materials entering manufacturing. Figure 57 shows the gross value of all manufactured products divided into component cost items for the 68 raw-material-consuming industries and for the 258 semimanufactured-material-consuming industries. Almost 54 percent of the value of products for the 68 industries represented expenditures for raw materials and only about 10 percent for purchased semimanufactures. Although the 68 industries produced only 28.1 percent of the value of all manufactured products, they consumed 83.5 percent of the total cost of raw commodities to manufacturing industry, 8.1 percent of the cost of semimanufactured commodities, and 49.0 percent of the cost of all fuels.

It is important to note that this small group of industries accounts for almost half of all the fuels and purchased electric energy used by manufacturing industries. Fuels and power add relatively more in the initial processing stages to the value of manufactured products than they do in the later steps necessary for production of finished commodities. That is, the first manufacturing stages are largely the application of heat, light, electrical, and mechanical energy to raw materials to convert them to forms useful to other producers. In the later stages of manufacture, fuels and power are used in each industry but not in such large amounts. The finishing operations are largely the application of skilled labor to semimanufactured materials. The fact that the raw-material-consuming industries demand large quantities of fuels and power complicates their location problem because many of them must look both to sources of their principal crude materials and to sources of energy.

TABLE 6.—*Percent distribution of value of products and of the cost of various kinds of materials for raw-material-consuming and for semimanufactured-material-consuming industry groups, 1929*

Industry group	Number of industries	Percent of all-industry total			
		Value of product	Cost of fuels and purchased electric energy	Cost of raw materials	Cost of semimanufactured materials
All industries, total	326	100.0	100.0	100.0	100.0
Raw-material-consuming industries	68	28.1	49.0	83.6	8.1
Food and kindred products	19	11.9	4.1	43.6	4.3
Textiles and their products	11	3.9	3.5	9.3	1.5
Forest products	4	.1	.1	.2	(1)
Paper and paper products	1	.3	.7	.8	.1
Chemicals and allied products	9	.9	.9	3.0	.3
Products of petroleum and coal	3	5.1	21.4	14.9	.9
Leather and its manufactures	1	.7	.4	2.3	.2
Stone, clay, and glass products	8	1.4	6.6	1.4	.1
Iron and steel and their products, except machinery	1	1.1	10.4	3.2	.2
Nonferrous metals and their products	3	.4	.7	1.0	.1
Miscellaneous	8	2.2	.2	3.8	.6
Semimanufactured-material-consuming industries	258	71.9	51.0	16.4	91.9
Food and kindred products	13	5.2	4.5	1.2	7.3
Textiles and their products	42	9.2	3.0	3.2	12.7
Forest products	16	5.0	1.9	1.7	5.4
Paper and paper products	9	2.4	3.6	.9	3.2
Printing, publishing, and allied industries	13	4.5	1.4	0	3.1
Chemicals and allied products	24	4.5	4.5	1.4	5.1
Products of petroleum and coal	2	.1	.2	(1)	.2
Rubber products	3	1.6	1.1	1.7	1.5
Leather and its manufactures	9	2.0	.4	0	3.3
Stone, clay, and glass products	12	.8	1.9	.3	.6
Iron and steel and their products, except machinery	25	9.0	14.4	1.9	11.4
Nonferrous metals and their products	20	4.7	2.8	3.5	7.5
Machinery, except transportation	16	10.0	5.9	.4	10.5
Transportation equipment, air, land, and water	10	8.6	2.9	(1)	15.1
Railroad repair shops	2	1.8	1.7	0	2.1
Miscellaneous	42	2.6	1.1	.2	2.8

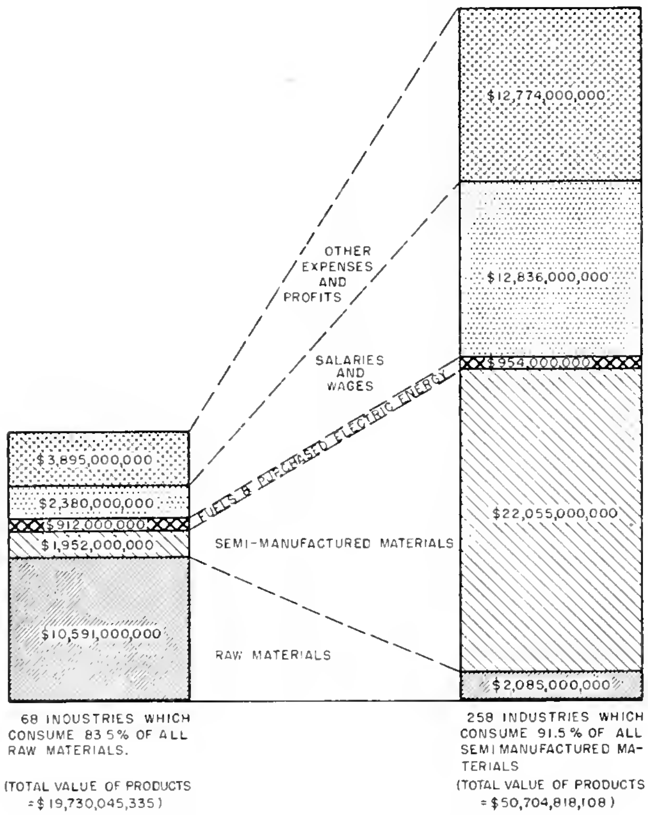
Source: Computed from Tracy E. Thompson, *op. cit.*
[1] Less than 0.5 percent.

The percent distribution of the value of products, cost of fuels, raw materials, and semimanufactured materials for industry groups, divided according to raw-material-consuming and semimanufactured-material-consuming industries, is shown in table 6. Three of the raw-material-consuming groups, namely food and kindred products, including 19 industries; textiles and their products, including 11 industries; and products of petroleum and coal, including 3 industries, use approximately 68 percent of the value of all raw materials. These 33 industries constitute about 10 percent of the number of manufacturing industries listed by the Bureau of the Census. Such facts indicate great concentration in the use of raw-materials by industry. The 19 food-processing industries alone consumed 43.6 percent of the value of raw materials. This group of industries is peculiar in that it also consumed 4.3 percent of the value of semimanufactured materials, a proportion which was more than half of the semimanufactured materials consumed in the 68 raw-material-consuming industries. The explanation

[6] In the case of sawmills, veneer mills, and cooperage stock mills the Census classification for the lumber and timber products industry supplies the reason why the cost of raw materials forms such a low proportion of total expenditures for materials. In that industry planing mills are included along with sawmills, veneer mills, and cooperage-stock mills. The raw materials in the form of logs enter the sawmills and are converted into various lumber products, which are classified as semimanufactures. These products in turn become the principal materials for planing mills and their value as semimanufactured materials are credited to the lumber and timber industry. Since no statistics are available separately for sawmills, veneer mills, and cooperage stock mills they are classified along with planing mills by the Bureau of the Census as industries consuming primarily semimanufactured materials.

[7] Cf. Tracy E. Thompson, *op. cit.*, p. 133.

GROSS VALUE OF PRODUCTS AND COMPONENT ITEMS FOR ALL MANUFACTURES BY RAW-MATERIAL-CONSUMING INDUSTRIES AND BY SEMI-MANUFACTURED MATERIAL-CONSUMING INDUSTRIES, 1929



SOURCE - MATERIALS USED IN MANUFACTURES: 1929 BY TRACY E. THOMPSON, U.S. DEPARTMENT OF COMMERCE, BUREAU OF THE CENSUS.

FIGURE 57

of this large proportion is that the 19 food-processing industries produced large amounts of commodities that were prepared for delivery to ultimate consumers.

The 258 industries classified as semimanufactured-material-consuming industries for 1929 used 91.9 percent of all semimanufactured materials, 16.4 percent of all raw materials, and 51.0 percent of fuels and purchased electric energy to manufacture 71.9 percent of the value of products (cf. fig. 57 and table 6). Almost 44 percent of the value of products of these industries represented expenditures for semimanufactured materials and only 4 percent expenditures for raw materials. In table 6 it is indicated that there is great concentration in the use of both raw and semimanufactured materials among the raw-material-consuming industries in the food, textile, and the petroleum and coal products groups. Among the consumers of semimanufactures there is no comparable concentration in the use of either raw or semimanufactured materials. Note, however, that little or no raw materials are consumed in the printing and publishing, rubber products, machinery, transportation equipment, and railroad repair shop industries classified among the 258 industries.

Figures 57 indicates that value added to materials forms a greater proportion of the value of products for semi-manufactured-material-consuming industries than for raw-material-consuming industries. Value added by manufacture constitutes 50.5 percent of the value of products for these industries compared with 31.8 percent for the raw-material-consuming industries. Wages and salaries form 25.4 percent of the value of products of the 258 industries whereas they constitute only 12.1 percent of the value for the 68 raw-material-consuming industries.

These differences imply a greater locational importance of labor employed in the 258 industries which produce the complicated finished products. The character of the work performed by the raw-material processors requires that they employ large numbers of unskilled and semiskilled workers such as machine operators and tenders. Since this type of labor is also required to a large extent by the extractive industries, there is a probability that at times the two fields of activity will compete for the available labor in a given area.[8]

Combination of Materials

Manufacturing industries differ widely in the variety of materials that must be brought together for their operations. The locational influence of materials depends in considerable part on the extent to which such materials are combined with other material. A strong locational attraction of a material in one area may be counteracted by an equally strong attraction of a second required material in another area. In general, the greater the multiplicity of materials, the less influential any one of them is likely to be in determining location. The effect of this counteraction might be more consideration for factors other than materials that yield a net advantage in the balancing of locational forces. It is quite possible, of course, that both material and nonmaterial factors will reinforce rather than work against each other. For example, the occurrence in Alabama of iron ore, coal, and limestone in proximity to each other and to Southern markets at some distance from other steel centers multiplies the advantages of that area for loca-

[8] The probabilities are that in the early development of new resources, there was no real growth of manufacturing in the immediate area because in such periods the extractive industries paid relatively high wages compared to manufacturing industries, and thus reduced the labor supply available there for manufacturing. This was one factor which, added to power, market, and other considerations, may have influenced certain industries to locate at some distance from the source of their raw material.

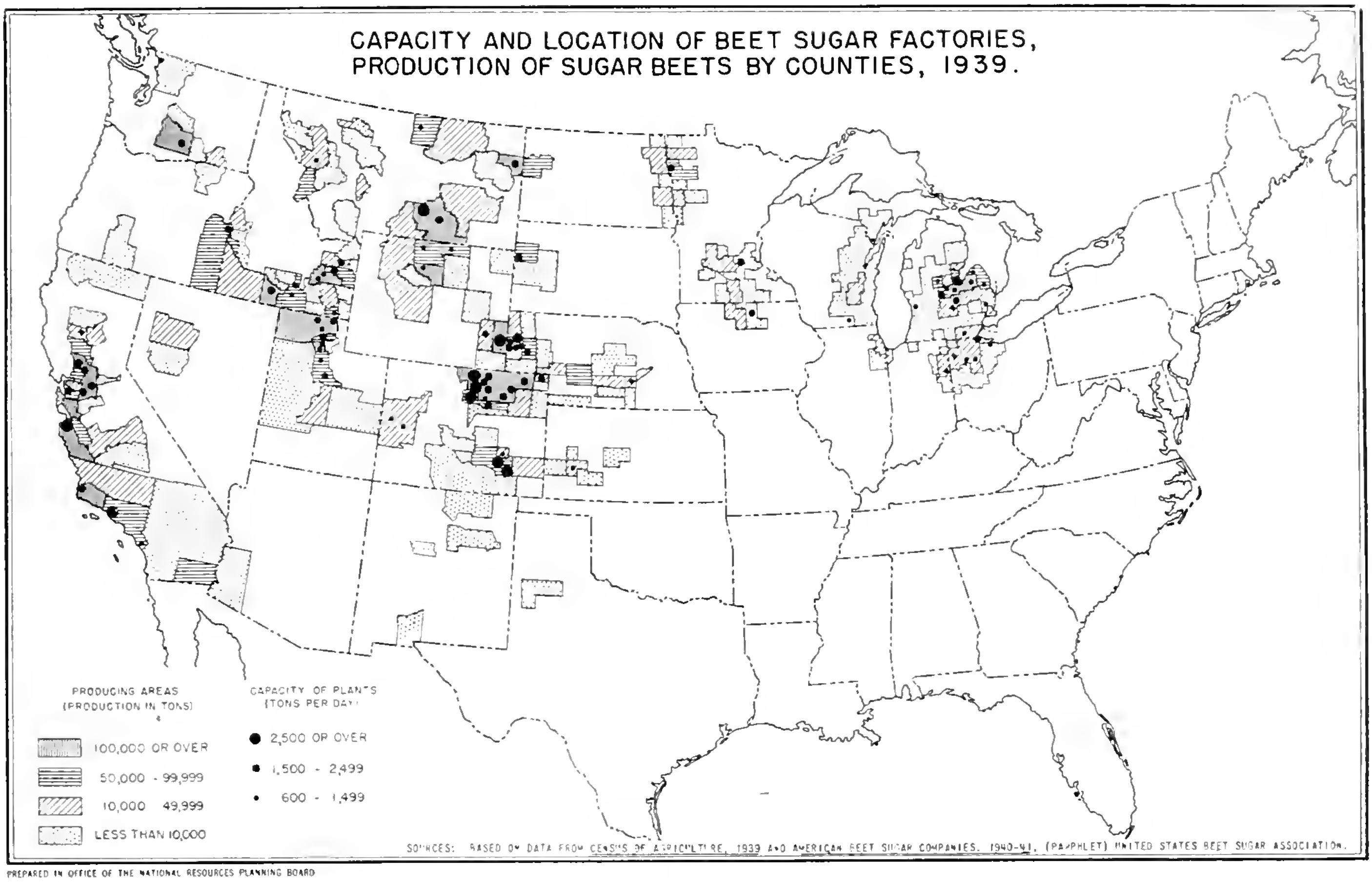


FIGURE 58

tion of steel plants. Such fortunate combinations are exceptions, however, rather than the rule. Even where sources of two or more materials are close, they are usually separated by some distance, whereas all of one material for a plant usually may be drawn from a localized source.

The possible combinations of materials are almost infinite in number. Nevertheless, four categories are adequate for analysis of the most recurrent types. Industries may be grouped into: (1) those that consume predominantly one material; (2) those that consume one major material and at least several important minor materials; (3) those that consume predominantly two materials; and (4) those that consume a variety of materials. In general raw-material-consuming industries tend to be the simpler types and the semimanufactured-material-consuming industries the more complex types. Generally, when an industry consumes three or more major materials the combination becomes complex, because industries of this type almost always consume a retinue of minor materials that also have some effect on location.

Combinations in Raw-Material-Consuming Industries

One of the best examples of dominance by a single material is found in the beet sugar industry, in which plants are almost without exception located in areas of sugar beet production. Nearly every major sugar-beet producing county has one or more sugar refineries (fig. 58). The perishable nature and the great reduction in bulk of sugar beets in the process of extraction of the sugar content, of course, helps to explain this coincidence in location. The lack of requirements for other materials in quantity from outside areas, of course, may be essential for location at the source of supply.

Wood pulp mills reflect a compromise between the source of a dominant material and a second less important requirement, fuel and power. In the pulp mills outlays for wood constituted 58.4 percent of total expenditures for materials in 1939 (table 7). The location of a pulp mill in a forest area is contingent on the availability of fuel, power, and water at that site. Lacking these, the wood supplies will not be used, or the plant will be built at a distance especially

if low-cost water transportation for the logs is a possibility. Fortunately water power is usually available in or near the forest areas to meet the needs of the mills. Wood pulp mills first located in New York, Massachusetts, New Hampshire, and Maine because of (1) the large supply of spruce and poplar which was the timber chiefly used in making wood pulp at that time, (2) the existence of low-cost water power necessary to operate the heavy grinding machinery, (3) the availability of suitable water for mixing the pulp, and (4) the adjacent markets for newsprint paper in Philadelphia, New York, and the New England cities. With the growth and geographic expansion of the market the industry followed sources of cheap wood and power. Its development in Wisconsin, Washington, Oregon, and the Southeastern Atlantic States was due largely to the abundance of forests and water power in those areas. In 1939, hemlock and southern yellow pine were by far the most important kinds of wood used by the industry; southern yellow pine alone supplied over 35 percent of the cordwood for the industry.

TABLE 7.—*Value of materials consumed in pulp mills, 1939*

Kind of material	Thousands of dollars	Percent of total
Total, all materials	144, 737	100. 0
Wood [1]	84, 539	58. 4
Other materials and supplies	43, 230	29. 9
Fuels	11, 403	7. 9
Purchased electric energy	5, 519	3. 8
Contract work	46	(2)

Source: *Census of Manufactures, 1939.*

[1] The total quantity of wood consumed was 10,816,466 cords.
[2] Less than 0.05 percent.

Occasionally a single-material industry will be notably market-oriented. The petroleum refining industry displays in part this characteristic, although much of the capacity is near the producing fields. Crude petroleum is by far the leading material (table 8). Practically full conversion of the crude petroleum to consumable products makes feasible the location of plants near markets. Increased demand for motor fuels and greater flexibility in adjusting refinery yields has accentuated this tendency. The development of the oil pipe line and the availability of cheap water transportation by tanker were important in determining the location pattern assumed by the oil refineries. These developments made it possible for the manufacturing plants to locate near densely populated consuming areas, even at great distances from the sources of raw materials. The pipe line originated as a plant facility. New discoveries in the use and operation of pipe lines were made available

TABLE 8.—*Quantity and value of materials consumed in the petroleum refining industry, 1939*

Kind of material	Quantity (short tons, except where noted)	Value	
		Thousands of dollars	Percent of total
Total, all materials		1, 933, 264	100. 0
Crude petroleum	[1,2] 1, 250, 256, 188		
Partially refined oils, tops, waxes, etc	[1,2] 63, 556, 255		
Natural gasoline	[1,3] 51, 785, 031		
Soda ash	11, 318	1, 861, 671	96. 2
Sulphuric acid [4]	924, 589		
Caustic soda, purchased	99, 297		
Fuller's earth	158, 386		
Other materials and supplies			
Anthracite	9, 129		
Bituminous coal	754, 113		
Coke	86, 171		
Fuel oils (including crude oil and gas oils)	[1] 37, 156, 306	58, 479	3. 1
Natural gas	[5] 115, 842, 098		
Manufactured gas	[5] 161, 724, 177		
Mixed gas	[5] 2, 896, 481		
Purchased electric energy		10, 904	. 6
Contract work		2, 210	. 1

Source: *Census of Manufactures, 1939.*

[1] Barrels of 42 gallons each.
[2] The average weight per barrel of crude petroleum is 308.8008 pounds. The crude petroleum consumed as raw material is equivalent, therefore, to approximately 193,039,555 short tons.
[3] The average weight per barrel of natural gasoline is 235.8115 pounds. The natural gasoline consumed as raw material is equivalent, therefore, to approximately 6,105,455 short tons.
[4] Includes purchased, produced in plant, reclaimed, and reused acid.
[5] Thousands of cubic feet.

to refineries, and now few refining establishments have been constructed outside of the oil fields away from deep water without their own pipe line connections.[9] In 1941 operations of petroleum refineries were located in 36 States with approximately 80 percent of the total refining capacity concentrated in 12 States; only about 40 percent of the total capacity was in the interior of the Nation and over half of the 1941 cracked-gasoline capacity was on locations adjacent to deep water.[10] The capacity near the coast lines in California and Texas is partly due to the location of nearby oil fields; but this and other capacity along the coasts far from oil fields indicate the importance of tanker transportation in determining the location of the refineries.

The flour and other grain-mill products industry might also be considered a single material industry. Wheat accounts for 77.2 percent of the total cost of materials (table 9). The quantity of this one raw material is so great that the sources of wheat would be expected to exert much influence on the location of flour mills. The large milling centers, such as Minneapolis, Buffalo, and Kansas City, however, are not in the midst of the producing areas but rather on the routes to the leading markets. Small reductions in bulk during milling and the freight rate structure, including the milling-in-transit privilege,[11] help to explain this location. The industry class is a somewhat mixed category which includes mills that manufacture

[9] J. E. Pogue, *Economics of the Petroleum Industry*, Chase National Bank, New York, p. 33.
[10] *Bureau of Mines Informotion Circular 7161*, April 1941.
[11] See chapter 9. *Transportation*, pp. 191–192.

TABLE 9.—*Quantity and value of materials consumed in the flour and other grain-mill products industry, 1939*

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials	....	[1] 492, 398	100. 0
Wheat	15, 241, 610	380, 135	77. 2
Corn	1, 743, 127	36, 572	7. 4
Oats	141, 545	3, 162	. 6
Rye	215, 684	3, 767	. 8
Barley	135, 483	2, 867	. 6
Buckwheat	19, 589	506	. 1
Rice and other grains	21, 590	574	. 1
Soybeans, whole beans	13, 194	340	. 1
Soybeans, bean-oil cake	29, 049	865	. 2
Sugar	95	8	(2)
Blackstrap molasses	38, 829	431	. 1
Wheat flour	27, 243	1, 050	. 2
Corn flour	7, 489	212	(2)
Buckwheat flour	2, 795	160	(2)
Rice flour	674	38	(2)
Other flour	2, 149	71	(2)
Phosphate	10, 970	1, 596	. 3
Soda	7, 681	312	. 1
Salt	11, 123	224	. 1
Seasonings, shortenings, and enriching materials	4, 363	626	. 1
Other materials and supplies	....	50, 296	10. 2
Anthracite	4, 187		
Bituminous coal	366, 405		
Coke	62		
Fuel oils (including crude oil and gas oils)	[3] 348, 951	2, 256	. 5
Natural gas	[4] 1, 733, 674		
Manufactured gas	[4] 30, 789		
Mixed gas	[4] 11, 834		
Purchased electric energy	....	6, 226	1. 3
Contract work	....	104	(2)

Source: *Census of Manufactures, 1939.*

[1] Estimated. The quantity and value of materials were reported in detail to the Bureau of the Census by establishments representing 97.3 of the industry as measured by the value of products. Total value of materials for all establishments was $506,061,519.
[2] Less than 0.05 percent.
[3] Barrels of 42 gallons each.
[4] Thousands of cubic feet.

TABLE 10.—*Quantity and value of materials consumed in the tobacco manufactures industries, 1939* [1]

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials	....	[2] 382, 922	100. 0
Leaf tobacco	393, 926	297, 914	77. 8
Cigarette paper	....	8, 283	2. 2
Beet sugar	854	75	(3)
Cane sugar	19, 024	1, 486	. 4
Corn sugar	487	28	(3)
Maple sugar	3, 642	1, 353	. 4
Licorice	12, 125	2, 855	. 7
Corn syrup	[4] 1, 832	91	(3)
Cane syrup and molasses	[5] 1, 102	47	(3)
Other materials and supplies	....	67, 562	17. 6
Anthracite	16, 958		
Bituminous coal	243, 044		
Coke	2, 807		
Fuel oils (including crude oil and gas oils)	[6] 36, 163	1, 239	. 3
Natural gas	[7] 15, 780		
Manufactured gas	[7] 20, 466		
Mixed gas	5, 351		
Purchased electric energy	....	1, 023	. 3
Contract work	....	966	. 3

Source: *Census of Manufactures, 1939.*

[1] The tobacco manufactures group comprises the cigarettes, cigars, and tobacco, (chewing and smoking) and snuff industries.
[2] Does not include the cost of internal revenue stamps for the tobacco industries. That cost, amounting to $589,115,175, is not considered as a material cost for this analysis.
[3] Less than 0.05 percent.
[4] The quantity of corn sirup reported was 318,531 gallons. The quantity by weight was calculated at 11.5 pounds per gallon.
[5] The quantity of cane sirup and molasses reported was 187,520 gallons. The quantity by weight was calculated at 11.75 pounds per gallon.
[6] Barrels of 42 gallons each.
[7] Thousands of cubic feet.

TABLE 11.—*Quantity and value of materials consumed in the blast furnace products industry, 1939*

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials	....	463, 719	100. 0
Iron ore (other than manganese)	57, 620, 305	238, 309	51. 4
Manganese ore	809, 593	12, 115	2. 6
Purchased sintered ore and flue dust	2, 707, 434	12, 027	2. 6
Scrap (iron and steel) purchased or transferred from other plants under same ownership	2, 679, 501	13, 311	2. 9
Limestone	10, 275, 588	13, 956	3. 0
Dolomite	1, 860, 230	2, 546	. 5
Other materials and supplies	....	8, 183	1. 8
Anthracite	[1] 31, 894		
Bituminous coal	[1] 452, 166		
Coke	[1] 31, 354, 793	145, 500	31. 4
Fuel oils (including crude oil and gas oils)	[1, 2] 246, 484		
Natural and manufactured gas	[1, 3] 7, 934, 902		
Purchased electric energy	....	1, 444	. 3
Contract work	....	16, 328	3. 5

Source: *Census of Manufactures, 1939.*

[1] Estimated. For 1939 the *Census of Manufactures* showed combined statistics on the quantity of fuels consumed in the blast furnace products industry and in the steel works and rolling mills industry. Quantity statistics were given separately, however, for each of these industries in the 1937 *Census of Manufactures*. Since the total quantities reported in the 2 years seemed comparable, the 1939 amounts of each fuel consumed were allocated between the industries in proportion to the 1937 figures.
[2] Barrels of 42 gallons each.
[3] Thousands of cubic feet.

products other than wheat flour and might, therefore, be considered a consumer of one major material and a long list of significant minor materials.

In terms of quantity and value the principal direct material of the tobacco industry is leaf tobacco, which constitutes 77.8 percent of expenditures for all kinds of materials (table 10). Several minor materials are of appreciable importance from the standpoint of both quantity and value. The group is not completely uniform since it includes industries manufacturing several types of products—cigarettes, cigars, chewing tobacco, and snuff—with differing requirements for materials.

A common class among raw-material-consuming industries is that which depends almost solely on two types of materials. This combination is prevalent among the metals-refining industries, in which ore and fuels or power are brought together. The blast furnace products industry, for example, consumed in 1939 nearly 58 million tons of iron ore and over 32 million tons of fuels; these two materials constituted 51.4 and 31.4 percent, respectively, of the total cost of materials, supplies, fuels, purchased electric energy, and contract work (table 11). Actually the tonnage of fuels required is understated by these data because the consumption is reported mostly as coke rather than as coal. Coke is now produced in byproduct ovens in the vicinity of the blast furnaces and the heavier material, coal, is handled and transported from distant sources. The tonnage of coal consumed directly in equivalent coke is roughly nine-tenths of the tonnage of ore consumed. Limestone consumption by the industry is the largest minor material, the quan-

TABLE 12.—*Quantity and value of materials consumed in the glass industries,[1] 1939*

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials		120,775	100.0
Silica sand	2,207,085	95,070	78.7
Soda ash	744,275		
Grinding sand	424,591		
Limestone	202,653		
Lime	201,474		
Feldspar	160,845		
Salt cake	38,287		
Other materials and supplies			
Anthracite	1,878	20,000	16.6
Bituminous coal	858,687		
Coke	628		
Fuel oils (including crude oil and gas oils)	[2] 1,085,861		
Natural gas	[3] 63,510,760		
Manufactured gas	[3] 2,124,374		
Mixed gas	[3] 372,020		
Purchased electric energy		5,534	4.6
Contract work		171	.1

Source: *Census of Manufactures, 1939.*

[1] The industry group comprises the following industries: Flat glass; glass containers; tableware, pressed or blown glass, and glassware not elsewhere classified.
[2] Barrels of 42 gallons each.
[3] Thousands of cubic feet.

tity used being a little more than 1 ton for each 6 tons of iron ore, but the value ratio in 1939 was only about 1 to 17. Furthermore, the locational influence of limestone is diminished by the fact that supplies of fluxing limestone are moderately easy to obtain.

Glass industries might be considered a dual-material group, owing to their consumption primarily of silica sand and fuels (table 12). Natural gas, fuel oils, and coal are consumed in quantity, but among these natural gas is most important measured by heat value. There has been a tendency for the industry to shift to the low-cost sources of gas, but much of the industry remains in the Appalachians where gas is now relatively costly for industrial plants. In these industries, too, there are establishments, especially those producing containers, tableware, and pressed and blown glass, that show the influence of markets on their location.

Finally, the cordage and twine, jute goods, and linen goods industry group consumes a complex assortment of raw materials, many of which are imported (table 13). Within the group there are establishments that specialize in certain materials, but the degree of specialization is not marked for the group as a whole.

A similar characteristic is shown by the canning and preserving industries. A wide variety of fruits and vegetables and of containers are used. The cost of fruits and vegetables is approximately the same as that of containers (table 14). Nevertheless, canning factories are not as a rule centralized to bring together the varied types of materials. They are, on the contrary, specialized and located close to the source of raw products to reduce spoilage and costs of transportation of the perishable, somewhat bulky materials. Assembly of products takes place after the manufacturing stage. There is thus a distinct difference between the industry requirements for combinations of products

TABLE 13.—*Quantity and value of materials consumed in the cordage and twine, jute goods (except felt), and linen goods industries, 1939*

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials		38,845	100.0
Hard fibers:			
Abacá (Manila fiber), Philippine	33,797	3,668	9.4
All other Abacá fibers	1,728	171	.4
Mexican sisal and henequen	29,470	1,872	4.8
Javanese sisal and henequen	25,643	2,195	5.7
African sisal and henequen	6,199	483	1.2
All other sisal and henequen fibers	4,385	326	.8
All other hard fibers (including istle, Mauritius, Maguey, etc.)	5,520	377	1.0
Soft fibers:			
Jute	61,525	6,118	15.8
Jute butts and rejections	4,349	259	.7
Hemp	888	263	.7
Cotton	34,966	5,897	15.2
Purchased yarns	7,039	3,756	9.7
Cotton waste (purchased only)	9,214	1,112	2.9
Old bagging, rope, etc., used as fiber stock	24,350	938	2.4
Other materials and supplies		9,522	24.5
Anthracite	8,835	524	1.3
Bituminous coal	56,599		
Coke	260		
Fuel oils (including crude oil and gas oils)	[1] 139,985		
Natural gas	[2] 17,576		
Manufactured gas	[2] 2,557		
Purchased electric energy		1,329	3.4
Contract work		[3] 35	.1

Source: *Census of Manufactures, 1939.*

[1] Barrels of 42 gallons each.
[2] Thousands of cubic feet.
[3] Value of contract work for the cordage and twine industry only. The figures for the jute goods and linen goods industries were not reported separately by the Bureau of the Census and are included with those for other materials and supplies.

TABLE 14.—*Value of materials consumed in the canned and preserved foods (except fish) industries, 1939* [1]

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials		[2] 468,698	100.0
Fruits and vegetables		181,890	38.8
Containers, boxes, cartons, etc		171,350	36.6
Cane sugar	198,859	18,039	3.9
Beet sugar	100,642	9,167	2.0
Corn sugar	12,785	953	.2
Other materials and supplies		79,381	16.9
Anthracite	17,260	4,787	1.0
Bituminous coal	656,231		
Coke	4,884		
Fuel oils (including crude oil and gas oils)	[3] 477,379		
Natural gas	[4] 4,520,778		
Manufactured gas	[4] 150,367		
Mixed gas	[4] 26,864		
Purchased electric energy		2,540	.5
Contract work		591	.1

Source: *Census of Manufactures, 1939.*

[1] The industry subgroup comprises the following industries: canned and dried fruits and vegetables (including canned soups) industry; preserves, jams, jellies, and fruit butters industry; pickled fruits and vegetables, and vegetable sauces and seasonings industry; salad dressings industry; and quick-frozen foods industry.
[2] Estimated. The quantity and value of materials were reported in detail to the Bureau of the Census by establishments representing 99.8 percent of the industry as measured by the value of products. Total value of materials for all establishments was $469,637,000.
[3] Barrels of 42 gallons each.
[4] Thousands of cubic feet.

and the individual plant requirements. The perishability of the raw fruits and vegetables makes the location of many of the operating plants something more than a problem in transportation. Just as the crushing of sugar cane or sugar beets and the boiling of the juice to molasses or coarse sugar must continue close to sources because of perishability, so must many small establishments be located close to plantations or farms to process raw fruits and vegetables. Yet this element of perishability, which binds particular establishments to widely scattered spots in spite of the economic attractions of other localities, is weakened by every new device to retard decay.[12] At present refrigerated fruit and vegetable shipments are in the service of the consumer market rather than to manufacturing industries located at some distance.

Combinations of Materials in Semimanufactured-Material-Consuming Industries

Industries that are classed as consumers of semimanufactures use a greater number of combinations of materials than do industries that consume principally raw materials. Some of the most striking examples of single material industries are in the semimanufactures-consuming group. On the other hand, the most complex combinations are also included. The tin can and other tinware industry is decidedly dependent on one semimanufactured material, tin plate

TABLE 15.—*Quantity and value of materials consumed in the tin cans and other tinware not elsewhere classified industry, 1939*

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials		[1] 244, 063	100.0
Tin plate	1, 760, 689	189, 315	77.6
Terneplate	134, 969	12, 079	5.0
Black plate	71, 188	5, 098	2.1
Steel sheets, plate and strip—hot-rolled (except stainless)	34, 283	1, 924	.8
Steel sheets and strip—cold-rolled (except stainless and vitreous enameled)	10, 914	757	.3
Stainless steel sheets and strip	4	5	(2)
Copper	314	106	(2)
Aluminum	77	57	(2)
Other materials and supplies		31, 852	13. t
Anthracite	8, 357	1, 321	.5
Bituminous coal	75, 285		
Coke	257		
Fuel oils (including crude oil and gas oils)	[3] 172, 007		
Natural gas	[4] 626, 930		
Manufactured gas	[4] 951, 669		
Mixed gas	[4] 90, 435		
Purchased electric energy		1, 51t	.6
Contract work		38	(2)

Source: *Census of Manufactures, 1939.*

[1] Estimated. The quantity and value of materials were reported in detail to the Bureau of Census by establishments representing 98.0 percent of the industry as measured by the value of products. The total value of materials for all establishments was $249,044,215.
[2] Less than 0.05 percent.
[3] Barrels of 42 gallons each.
[4] Thousands of cubic feet.

TABLE 16.—*Quantity and value of materials consumed in the "wire drawn from purchased rods" industry, 1939* [1]

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials		99, 952	100.0
Hot-rolled iron and steel bars	46, 516	2, 097	2.1
Wire rods, iron and steel	667, 203	29, 153	29.2
Copper bars and rods	116, 946	26, 066	26.1
Brass and bronze bars and rods	5, 087	1, 433	1.4
Hot-rolled sheets and strip steel	42, 151	2, 640	2.6
Steel wire (purchased as such)	33, 962	2, 499	2.5
Zinc	12, 613	1, 339	1.3
Other materials and supplies		29, 776	29.8
Anthracite	39, 049	2, 242	2.2
Bituminous coal	172, 622		
Coke	994		
Fuel oils (including crude oil and gas oils)	[2] 328, 228		
Natural gas	[3] 835, 957		
Manufactured gas	[3] 814, 818		
Mixed gas	[3] 19, 691		
Purchased electric energy		2 587	2.6
Contract work		150	.2

Source: *Census of Manufactures, 1939.*

[1] Does not include wire departments of rolling mills.
[2] Barrels of 42 gallons each.
[3] Thousands of cubic feet.

TABLE 17.—*Quantity and value of materials consumed in the steel castings industry, 1939*

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials		[1] 44, 327	100.0
Scrap rails, axles, bars, and other iron and steel scrap	577, 310	8, 850	20.0
Pig iron	147, 093	3, 075	6.9
Ferro alloys (except manganese)	11, 430	1, 374	3.1
Ferro manganese	12, 994	1, 071	2.4
Nickel	1, 315	865	2.0
Aluminum	341	135	.3
Iron ore	7, 622	67	.2
Nonferrous alloys	187	51	.1
Copper	41	9	(2)
Copper scrap	13	3	(2)
Other materials and supplies		19, 627	44 3
Anthracite	5, 539	3, 717	8.4
Bituminous coal	204, 696		
Coke	30, 982		
Fuel oils (including crude oil and gas oils)	[3] 960, 970		
Natural gas	[4] 3, 757, 926		
Manufacture gas	[4] 143, 877		
Mixed gas	[4] 522, 473		
Purchased electric energy		4, 896	11.0
Contract work		587	1.3

Source: *Census of Manufactures, 1939.*

[1] Estimated. Quantity and value of materials were reported in detail to the Bureau of the Census by establishments representing only 98 percent of the industry as measured by the value of products produced. Total value of materials for all establishments was $45,232,070.
[2] Less than 0.05 percent.
[3] Barrels of 42 gallons each.
[4] Thousands of cubic feet.

(table 15). The wire industry using purchased rods consumes, in terms of tonnage, mainly one material, iron and steel wire rods, and, in terms of value, an additional important material, copper bars and rods (table 16). The steel castings industry uses in major part iron and steel scrap as material (table 17). Raw materials are almost completely absent from the list of materials consumed, but it should be noted that outlays for purchased electric energy and for supply items not counted as materials proper bulk very large.

[12] Cf. L. A. Ross, "The Location of Industries," *Quarterly Journal of Economics*, April 1896, p. 252.

TABLE 18.—*Quantity and value of materials consumed in the steel works and rolling mills industry, 1939*

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials		1, 572, 472	100.0
Iron ore	3, 127, 991	18, 488	1.2
Pig iron	31, 460, 439	428, 489	27.2
Steel ingots	348, 883	11, 715	.7
Blooms, billets, and slabs	8, 265, 908	221, 103	14.1
Sheet and tin-plate bars	1, 729, 055	47, 162	3.0
Ferro-alloys (except manganese)	317, 444	36, 890	2.3
Ferro manganese	373, 176	25, 677	1.6
Scrap rails, axles, bars, etc., for rolling	1, 373, 464	21, 892	1.4
Other scrap iron and scrap steel (purchased)	12, 025, 975	162, 413	10.3
Zinc	194, 474	19, 598	1.2
Pig tin	44, 906	40, 905	2.6
Aluminum	15, 487	5, 074	.3
Nickel	23, 436	14, 030	.9
Copper	41, 446	8, 904	.6
Copper scrap	4, 860	765	.1
Nonferrous alloys scrap	11, 567	2, 867	.2
Other materials and supplies		342, 092	21.8
Anthracite	[1] 311, 051		
Bituminous coal	[1] 8, 775, 706		
Coke	[1] 738, 137	125, 990	8.0
Fuel oils (including crude oil and gas oils)	[1, 2] 27, 140, 574		
Natural and manufactured gas	[1, 3] 1, 125, 622, 535		
Purchased electric energy		35, 804	2.3
Contract work		2, 614	.2

Source: *Census of Manufactures, 1939.*

[1] Estimated. For 1939 the *Census of Manufactures* showed combined statistics on the quantity of fuels consumed in the blast furnace products industry and in the steel works and rolling mills industry. Quantity statistics were given separately, however, for each of these industries in the 1937 *Census of Manufactures*. Since the total quantities reported in the 2 years seemed comparable, the 1939 amounts of each fuel consumed were allocated between the industries in proportion to the 1937 figures.
[2] Barrels of 42 gallons each.
[3] Thousands of cubic feet.

TABLE 19.—*Quantity and value of materials consumed in the bread and other bakery products and the biscuit, crackers and pretzels industries, 1939*

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials		[1] 637, 786	100.0
White wheat flour	4, 103, 061	188, 033	29.5
Whole-wheat (including graham) flour	191, 053	9, 214	1.4
Rye flour	167, 278	7, 603	1.2
Other flour	143, 043	10, 768	1.7
Beet sugar	191, 564	18, 144	2.8
Cane sugar	371, 105	35, 682	5.6
Corn sugar	65, 337	5, 122	.8
Corn sirup	25, 192	1, 680	.3
Eggs, fresh, frozen, dried or canned	(2)	33, 898	5.3
Butter	19, 591	10, 802	1.7
Oleomargarine	15, 509	3, 446	.5
Lard	142, 086	22, 444	3.5
Shortenings other than lard	205, 690	40, 581	6.4
Fluid milk	68, 898	5, 488	.9
Condensed and evaporated milk	84, 865	9, 656	1.5
Powdered milk	84, 340	12, 664	2.0
Malt extract	20, 088	2, 913	.5
Fruit	(2)	21, 971	3.4
Yeast	73, 885	20, 642	3.2
Salt	94, 603	1, 854	.3
Containers	(2)	82, 064	12.9
Other materials and supplies		63, 086	9.9
Anthracite	282, 133		
Bituminous coal	517, 392		
Coke	174, 880		
Fuel oils (including crude oil and gas oils)	[3] 1, 899, 174	17, 850	2.8
Natural gas	[4] 9, 722, 767		
Manufactured gas	[4] 5, 340, 010		
Mixed gas	[4] 1, 209, 110		
Purchased electric energy		12, 172	1.9
Contract work		8	(5)

Source: *Census of Manufactures, 1939.*

[1] Estimated. The quantity and value of materials were reported in detail to the Bureau of the Census by establishments representing only 98.2 percent of the combined industries as measured by the value of products. Total value of materials for all establishments was $649,476,628.
[2] Data not available.
[3] Barrels of 42 gallons each.
[4] Thousands of cubic feet.
[5] Less than 0.05 percent.

This tendency to depart from a close dependence on materials that enter directly into the product is decidedly noticeable in most of the semimanufactures-consuming industries.

Steel works and rolling mills further exemplify industries that consume primarily one or two types of materials, in this instance pig iron and to some extent scrap iron and steel (table 18). A long list of supplementary materials, however, is also consumed. The assembly of materials is clearly not the chief problem of this industry; rather it is the synthesis of a semimanufactured commodity to provide finished iron and steel products both for further manufacturing and for ultimate consumers. Note, too, that the list of materials indicates considerable shifting or transfer of semifinished products among establishments within the industry, for blooms, billets, slabs, sheets, bars, and similar commodities are semimanufactured products of the industry. In particular they are the products of the larger, more integrated concerns which sell to less completely equipped establishments in the industry.

The bread and bakery products industry, on the contrary, well illustrates the semi-manufactured-material-consuming industries that bring together a large number of materials to produce commodities for ultimate consumers. Wheat flour, however, is consumed in far larger amounts than any other material (table 19). Accordingly, the industry should be considered as one that consumes a major material and a group of minor, or secondary, materials. The outlay for containers, an item of substantial importance, is of interest as a characteristic feature of industries that prepare commodities, usually from semimanufactures, for wide distribution to consumers. The bakery industries are market oriented, for their final products are much more perishable than their starting materials. It is interesting to contrast the location of this industry with that of an industry, such as canning and preserving, which processes perishable materials and which must locate close to the sources of materials.

Another linkage of the semimanufactured-material-consuming industries with consumers through materials is illustrated by paper and paperboard mills which also consume one major material along with several significant minor materials (table 20). The outstanding material is woodpulp which constitutes 52.0 percent of the total expenditures for material by the industry. The leading minor material, waste paper, is obtained from substantially the same sources as the market for the finished product. Since woodpulp is not subject to much weight loss during the manufacturing process, it is to be expected that the

TABLE 20.—*Quantity and value of materials consumed in the paper and paperboard mills industry, 1939*

Kind of material	Quantity (short tons)	Value	
		Thousands of dollars	Percent of total
Total, all materials		532, 261	100. 0
Sulphite woodpulp	2, 912, 704	131, 720	24. 7
Sulphate woodpulp	3, 354, 338	86, 506	16. 3
Mechanical woodpulp	1, 749, 118	34, 445	6. 5
Soda woodpulp	515, 650	22, 212	4. 2
Semichemical woodpulp	118, 613	1, 636	. 3
Manila stock (rope, jute, bagging, etc.)	64, 149	2, 233	. 4
Rags	468, 287	14, 808	2. 8
Waste paper (paper stock)	4, 366, 257	57, 293	10. 8
Straw	512, 993	3, 400	. 6
Other fiber (cotton, etc.)	115, 173	3, 186	. 6
Casein	17, 587	3, 244	. 6
Clay	427, 481	7, 481	1. 4
Rosin	35, 915	1, 941	. 4
Rosin sizing	94, 325	4, 980	. 9
Other nonfibrous materials (alum, starch, etc.)	571, 115	22, 929	4. 3
Other materials and supplies		75, 223	14. 1
Fuels		43, 507	8. 2
Purchased electric energy		15, 387	2. 9
Contract work		130	(1)

Source: *Census of Manufactures, 1939.*

[1] Less than 0.05 percent.

paper mills may be scattered and are not necessarily located near pulp mills.

Census data do not adequately reflect the extreme complexity of materials typical of many of the industries consuming semi-manufactures. Producers of electrical machinery, apparatus, and supplies place many products on the market which are composites of numerous materials. For example, the raw materials used to make parts for the common telephone set are as follows:

Aluminum.	Phenol resin.
Anthracite.	Quartz.
Asphalt.	Rubber.
Brass.	Silk.
Cellulose acetate.	Silver.
Gold.	Cobalt.
Hemp.	Copper.
Iron.	Cotton.
Leather.	Flax.
Mica.	Galena.
Chinawood (tung) oil.	Tin.
Linseed oil.	Waxes.
Kauri gum.	Shellac.
Chromium.	Wool.
Clay and talc.	Zinc.

These materials must be assembled from many sources, both domestic and foreign. Most of the materials are obtained indirectly as semimanufactures, for the manufacturer of the telephone sets does not start his work with all the basic raw substances. The total amounts of each material needed are small, and the value of each is small in proportion to the final value of the finished telephone set. Manufacturers specializing in such composite products tend to choose large industrial areas for a factory location because of better business and service facilities, and because of the procurement and assembly problems of the materials. The chances are that an area where a variety of products are manufactured will be favored, and that no one or two materials will have much influence on the choice of location.

Sequence of Materials

The way in which materials pass through successive stages of production may determine the location patterns. The stages may have to be closely tied together, as in some branches of the metal industries where it is preferable to process the materials through two or more stages before allowing them to cool. One or more stages may be self-contained units, as is common in the cloth industry which does not need to be directly connected with dyeing or garment manufacture; or one stage may be followed by a variety of later stages, as illustrated in the diverse uses of steel billets. Occasionally stages may be combined or eliminated, with the result that the production is unified at one location or results in a shortened sequence. The rayon industry has condensed processes in place of the various stages required for thread production under the older operations. Production of cloth from synthetics without spinning or weaving operations illustrates the elimination of stages. The chaining together of stages depends partly on whether the output of all or most of a stage is required by a succeeding stage. No doubt one of the reasons for location of byproduct coke plants at iron and steel plants is the existence on the spot of consumption needs suitable and adequate to afford efficient operation of the ovens for coke, coal gas, and other coal products. Were the consumption of coke for other uses larger, there would be more incentive to locate a greater share of the establishments elsewhere.

Specialization of Materials

Crude materials for industry almost invariably have less specialized use possibilities than finished products. Iron ore can be made into any kind of iron or steel product. After the ore has been converted into a special type of iron or steel—high carbon, low carbon, or one of many alloys—its possibility of varied use becomes limited. The final product, whether it is a producers' or a consumers' commodity, may have no value except for a single use or as scrap material for reworking. The effect of this specialization is a difference in point of view with regard to location. In many instances, perhaps a majority of instances, the unspecialized product may be distributed to a market less widespread than that for the specialized product. This increasing dispersion results in large part from the channeling of

TABLE 21.—*Quantity and value of materials consumed in the chocolate and cocoa products industry, 1939*

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials		63,460	100.0
Cocoa beans	272,505	28,547	45.0
Beet sugar	16,714	1,447	2.3
Cane sugar	111,798	9,794	15.4
Corn sugar	831	69	.1
Corn sirup	4,158	219	.3
Creamery butter	686	346	.5
Milk (fluid, condensed and evaporated, and powdered)		6,138	9.7
Nuts		2,990	4.7
Other materials and supplies		12,444	19.6
Anthracite	2,701		
Bituminous coal	129,097		
Coke	101		
Fuel oils (including crude oil and gas oils)	[1] 86,547	737	1.2
Natural gas	[2] 937		
Manufactured gas	[2] 39,323		
Mixed gas	[2] 1,299		
Purchased electric energy		728	1.2
Contract work		0	.0

Source: *Census of Manufactures, 1939.*

[1] Barrels of 42 gallons each.
[2] Thousands of cubic feet.

TABLE 22.—*Quantity and value of materials consumed in the candy and other confectionery products industry, 1939*

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)	Value	
		Thousands of dollars	Percent of total
Total, all materials		[1] 162,028	100.0
Beet sugar	128,200	11,608	7.2
Cane sugar	225,941	20,899	12.9
Corn sugar	11,014	829	.5
Invert sugar (nulomoline etc.)	14,047	1,187	.7
Milk (fluid, condensed and evaporated, and powdered)		3,544	2.2
Corn starch	11,487	743	.5
Gelatine	1,095	897	.5
Cream (butterfat)	1,348	460	.3
Chocolate coatings (purchased and used)	104,687	21,762	13.4
Chocolate liquors (purchased and used)	6,637	1,280	.8
Creamery butter	1,034	585	.4
Cocoanut (shred, thread, etc.)	15,090	2,314	1.4
Cocoa beans	2,845	335	.2
Cocoa butter	8,156	2,079	1.3
Cocoa powder		290	.2
Corn syrup	251,138	12,996	8.0
Nuts and peanuts	126,072	24,202	14.9
Chicle	117	79	.1
Crude gums (used in chewing gum)	349	107	.1
Essential oils		727	.4
Flavoring extracts		1,340	.8
Other materials and supplies		50,047	30.9
Anthracite	10,682		
Bituminous coal	165,957		
Coke	4,679		
Fuel oils (including crude oil and gas oils)	[2] 275,289	1,745	1.1
Natural gas	[3] 727,047		
Manufactured gas	[3] 341,097		
Mixed gas	[3] 176,891		
Purchased electric energy		1,815	1.1
Contract work		158	.1

Source: *Census of Manufactures, 1939.*

[1] Estimated. The quantity and value of materials were reported in detail to the Bureau of the Census by establishments representing 94.9 percent of the industry as measured by the value of products. Total value of materials for all establishments was $170,735,600.
[2] Barrels of 42 gallons each.
[3] Thousands of cubic feet.

products into sizeable individual producing units, but into increasingly complex types of use. Raw-material industries are identified mainly with the character of material consumed, and finished-good industries mainly with the character of use of the products. This difference is clearly shown in the industry classifications of the *Census of Manufactures.*

Degree of specialization is, in general, inversely related to extent of combination of materials. Typically a raw material is formed into a variety of products which are in turn combined with other products also derived from raw materials. The combinations may be continued in succeeding stages of production. These transformations may be observed in the chocolate and cocoa products industry in conjunction with the candy and other confectionery products industry. In the former industry expenditures for cocoa beans constitute almost half the cost of all materials (table 21). Cocoa beans are processed and combined with other materials—sugar, syrup, butter, milk, and nuts—for use in part of the confectionery industry, which consumes a long list of materials and which manufactures special-use products (cf. table 22). There are, of course, some comparatively rare exceptions to correlation of increasingly specialized use with advance in the stage of manufacture. Certain wood resources may be valuable only for wood pulp, whereas succeeding stages may be less specialized.

Substitution of Materials

Materials used in manufacture may be divided broadly into two classes for considering location factors in connection with production requirements and assembly of materials. First, there are those materials with respect to which the manufacturer has considerable latitude in the choice of the one to be used for his manufacturing process. Second, there are those materials which are unique with regard to particular manufacturing processes. The differentiation is roughly between materials that permit substitution in greater or lesser degree to accomplish a given purpose and materials that permit no substitution. Fuels are good examples of widely used materials of the first type. The manufacturer usually has two or more fuels from which to choose the one most satisfactory for his purpose and most economical from an operating point of view. Many manufacturing processes are so constituted, however, that there is one best fuel, but there usually are possibilities of using substitutes in emergencies. Another example of the first type is the manufacture of kitchen utensils. For these articles, iron, copper, aluminum, many alloys, or even glass may be chosen. An example of the second type is the production of high-grade carbon black, in which, under present commercial processes, natural gas is indispensable. This special requirement of a consuming industry should be distinguished from specialization of a product.

In this case natural gas, although a unique material for making carbon black, does have other uses.

The majority of the industrialists requiring semi-manufactured materials make use of materials of the first type, that is, of those for which substitutes are available, but perhaps at large difference in cost. To such a manufacturer problems in regard to materials involve the economies of the choice and the assembly of commodities. The location of his establishment may not depend solely on the source of one particular commodity. On the other hand, manufacturers engaged in basic process activities are more concerned with getting unique materials. The establishment whose chief function is to produce refined lead must have lead ores; sawmills must have logs; and blast furnaces must have iron ore, coke, and limestone. To such manufacturers the sources of materials receive more serious consideration.

Physical Changes of Materials in Processing

If the cost of the materials becomes a large proportion of the value of the finished products and if the loss of weight during processing is great, sources of raw materials become of real importance in the location of manufacturing unless the materials are so plentiful that they may be obtained almost anywhere at equal costs. Few materials, of course, are so widely available.

It has been shown that among industries with large expenditures for crude commodities there is a strong tendency to locate near the source of raw materials. But even among these the influence of materials is not always great enough to warrant the presumption that the processing factories will be located near the most advantageous source of materials.

Industries located near their market but with a high proportion of expenditure for raw materials are likely to be those that use raw materials in which there is little or no weight loss in the processing operations. For example, in the petroleum refining industry many refineries are located close to the consumer market, and at distances of more than 1,000 miles from the source of crude oil. In this industry the primary material, crude oil, is almost fully converted to marketable products. The pull of the market in such cases will, therefore, exert a much greater influence relatively because, assuming equal or approximately equal freight rates, it makes little difference whether the crude materials or the finished products are transported. This factor has been further accentuated by greater flexibility in refining methods which permit adjusting the products to the market.

On the other hand, industries such as the primary smelting of nonferrous metals use raw materials which undergo considerable loss of weight in processing. As seen in chapter 1 of this report, *Mineral Resources*, the production of crude ores of copper, lead, zinc, silver, and gold accounts for huge tonnages of materials. The yield of refined metal from these ores, however, is small, being less than one percent in many instances. The smelting activities are located close to the mines, except possibly where fuel requirements cannot be met satisfactorily in the vicinity of the mines. Zinc smelting in Pennsylvania is an example. Although the State produces no zinc ores, zinc smelters are located there to obtain the advantages of a large supply of coal which loses substantially all of its weight in the smelting process. Iron ore refining presents a peculiar case in that the ores mined at present are usually so rich in metal content that generally they tend to move toward the fuel-producing areas for smelting or to a market center between the sources of iron ore and fuel. In the canning and drying of fruits and vegetables, establishments are located close to the sources of raw materials both because of the weight-loss factor and because the raw fruits and vegetables are perishable commodities in which delays increase the possibilities of loss. For similar reasons establishments in the cheese and creamery butter industries are located close to the farms. Canning, drying, and other means for preserving not only conserve perishable commodities in desirable forms for use at appropriate times, but also make possible shipment to distant areas. Consequently, the industry whose function it is to preserve the commodities must necessarily locate close to the source of supply. It is possible, of course, to apply one means of preservation until a later one can be applied. Refrigeration of fruits, for example, enables shipment to a canning center far away from the source of supply. Salting of hides and pelts to preserve them until they can be cured illustrates another expedient.

The stage of perishability may be altered. Before introduction of refrigerator cars, livestock was shipped to packing plants or butcher shops near the markets because slaughter of the livestock converted it into a perishable product.

Weight changes in commodities during processing operations almost always are in the direction of reductions. Space requirements for commodities, however, may either decrease or increase with successive stages of manufacture. When metallic ores are concentrated or refined, they decrease in cubic content, but when they are converted into a product, such as an electric refrigerator, they occupy an enlarged space. This reduction and expansion of space requirements, so typical of present-day production, is in no small measure responsible for orientation of initial processing industries near the source of supply of raw materials and of final

processing industries near the ultimate markets. A good example is the manufacturing of agricultural machinery. Establishments in that industry are generally close to their farm markets. It is more convenient and cheaper to transport, process, and assemble the heavy semimanufactured materials such as rods and steel shapes, lumber, and special castings to points closer to markets than to ship finished agricultural machinery from a location close to iron and steel producing centers. The obvious reason for this is that finished agricultural machinery such as a hay rake, a binder, or a combine are bulky and consequently are difficult to handle and expensive to transport. Automobile manufacturers have established branch assembly plants to which it is more economical to send finished parts for assembly rather than to ship the bulky assembled automobile to the market centers.

The fertilizer industry provides an interesting case of changes in weight, space requirements, and perishability. The long list of materials consumed in this industry is shown in table 23. In 1935 fertilizer manufacturing establishments were in 329 counties in the United States. For the industry as a whole the establishments are usually orientated to their sources of materials. Since a variety of materials are used in the industry and usually only few kinds are used in particular establishments, the processing plants are near many different sources which produce the principal materials utilized. Thus there are fertilizer establishments near such places as meat-packing centers, fishing areas, deposits of phosphate rock, and garbage collecting centers. Usually the fertilizer establishments may be classified as two types—the organic refuse and the inorganic phosphorous-potash-nitrogen plants. The first type use perishable materials that undergo great loss of weight in processing. The inorganic type tend to conduct their activities in large central chemical factories whose highly concentrated products are shipped to local mixing plants where carriers, chiefly inert and alkali ingredients, are added to dilute the concentrates to usable proportions. Fertilizer manufacturing is more important in the South than anywhere else in the United States. Sulphur and phosphate rock mining, sulphuric acid manufacturing, and the production of cottonseed meal are closely interrelated with fertilizer manufacturing in that area. Most of the Southern establishments use large quantities of sulphuric acid to process fertilizers based on the phosphate rock mined in Florida, Tennessee, and Virginia. Both the loss of weight and bulk in processing the materials and the perishable nature of some of the materials encourage the fertilizer plants to locate near their principal sources of materials.

Because industrial production processes are complex, finished commodities may lose much of the essential physical characteristics of their original materials or material sources. The chief basic raw materials for the electric generator and motor units for an automobile are copper ore, iron ore, and cotton. The electrical machinery industry may obtain semimanufactured goods processed from these raw commodities by factories such as smelting and refining plants, steel works, rolling mills, and textile mills. The manufacturer of the final product is dependent for materials on many other manufacturers, most of whom are themselves several steps removed from the original material. He is not, therefore, directly concerned with copper ore, iron ore, or cotton when considering materials for an automobile generator.

Well developed transportation facilities and efficiency of first-stage manufacture have removed much of the dependency of users of semimanufactures on sources of raw materials. The semifinished goods can be made available to meet manufacturers' requirements of interchangeability, consistency, and appearance in such manner that there is little or no waste of material in the final processing. The fact that the alteration of the physical form of raw materials is segregated leads the manufacturer of final consumers' goods to give little heed to extractive areas in the location of his plant.

TABLE 23.—*Quantity of materials consumed in the fertilizer industry, 1939*

Kind of material	Quantity (short tons, except as noted for fuel oils and gas)
Sulphate of ammonia	339,590
Nitrate of soda	87,793
Ammonia anhydrous	13,047
Ammonia, aqua, bases 25 percent NH_3	77,289
Calcium cyanamid	34,779
Urea and calurea	16,305
Ammonium phosphate	27,356
Cal nitro	45,145
Other inorganic nitrogenous materials	69,476
Cottonseed meal	75,903
Tankage (processed)	92,638
Tankage (animal) and dried bloods	53,951
Tankage (garbage)	31,091
Fish scrap and meal	39,067
Guano (all kinds)	27,063
Sewage sludge	17,300
Other organic nitrogenous materials	175,462
Bones, ground, steamed, etc	15,775
Superphosphate, basis 16 percent A. P. A	2,816,537
Muriate of potash, basis 50 percent K_2O	496,703
Sulphate of potash	56,389
Manure salts, basis 20 percent K_2O	31,083
Kainite	19,434
Other potash-bearing materials	66,066
Other material containing plant food	268,859
Phosphate rock	2,029,060
Sulphuric acid purchased and consumed	717,360
Sulphuric acid made and consumed, basis 50 percent Baumé	1,161,770
Phosphoric acid	119,754
Anthracite	249
Bituminous coal	78,072
Fuel oils (including crude oil and gas oils)	[1] 153,045
Natural gas	[2] 285,090
Manufactured gas	[2] 3,572
Mixed gas	[2] 1,208

Source: *Census of Manufactures, 1939.*

[1] Barrels (42 gallons per barrel).
[2] Thousands of cubic feet.

Recovery of Scrap Materials

During recent years the use of scrap materials, particularly of iron and steel, has increased in quantity. Two reasons are frequently advanced as an explanation. First, more scrap materials are available because of the greater use of durable goods over a long period of time. Second, there is more salvaging activity because of improved markets for certain scrap articles. As technological developments extend the use of metal products and as mining operations continue to bring more metals into use, the recovery of scrap metals will tend to increase in somewhat the same proportion.

Scrap materials are usually described as "old" and "new" scrap in the nonferrous metal industries and as "home" and "purchased" scrap in the iron and steel industry. According to the Bureau of Mines, "old" scrap is defined as scrap derived from metal articles that have been discarded after having served a useful purpose. Typical examples of old scrap are discarded electric wire, battery plates, automobile parts, valves, and lithographers' plates. "New" scrap is defined as the refuse produced during the manufacture of articles, including all finished and semifinished articles that are reworked. Typical examples of new scrap are turnings, borings, skimmings, drosses, slags, and articles discarded because of faulty manufacture. The essential difference between old and new scrap is that the former represents metal that has been in use, whereas new scrap is essentially metal that has not yet reached the stage of final use.

The nonferrous scrap materials are often referred to as secondary metals to distinguish them from primary metals which are derived directly from ores. This distinction does not imply that secondary metals are of inferior quality, for metals derived either from ore or from waste material vary in purity and in adaptability to use. The chief secondary metals prepared for the market are copper, lead, zinc, tin, aluminum, antimony, and nickel. Large amounts of these are used by automobile industries, and the reworking of scrap nonferrous metals will undoubtedly increase with the upward trend in the total use of nonferrous metals. In fact, the use of secondary metal that may be a byproduct of manufacturing operations has become such an important factor in the saving of nonferrous metal, that in recent years much of this type of scrap has not reached the secondary metal market because manufacturers have improved their facilities for using their own scrap. In addition there is a growing tendency for producers to take back scrap directly from their customers in trade-in agreements, and such metals also do not reach the secondary metal market. In general there is a larger reclamation of the metal consumed in capital goods than in consumer goods because the former are more accessible to manufacturers and scrap dealers after they have served their purpose. New scrap, as defined, is found only in industrial areas, but old scrap may be found wherever durable products are used. Because of the widespread distribution of consumer goods, old scrap derived from such sources presents greater salvage problems, and accordingly the amount of such scrap recovered is much more sensitive to changes in prices offered for secondary metals.

TABLE 24.—*Percent of total ferrous scrap and pig iron charged to iron and steel furnaces in the United States, 1939*

Ferrous scrap and pig iron	Percent of total charge to—		
	Steel furnaces [1]	Iron furnaces [2]	All furnaces
Home scrap	26.4	31.7	27.4
Purchased scrap	21.0	33.4	23.4
Pig iron	52.6	34.9	49.2

Source: U. S. Bureau of Mines, *Minerals Yearbook, 1940.*

[1] Includes open-hearth, bessemer, and electric furnaces.
[2] Includes cupola, air, Brackelsberg, puddling, crucible, and blast furnaces; also direct castings.

Data reported in the *Minerals Yearbook* from consumers of iron and steel scrap are only for scrap used in the remelting processes. "Purchased" scrap is there defined to include scrap obtained from sources outside the consuming plant, scrap transferred from other plants of the same company, and scrap obtained under exchange contracts or conversion agreements. "Home" scrap is defined to include all scrap materials resulting from manufacturing processes as well as old materials salvaged within the consuming firm. Note that purchased scrap and home scrap may include both old and new scrap materials as defined for nonferrous secondary materials. Home scrap is generally considered as recycled material or run-around scrap which constitutes a rotating working stock rather than material for actual consumption. Because this scrap, however, is definitely a part of iron and steel furnace charges, it must be considered to obtain a complete picture of raw-material consumption in iron and steel manufacture. Table 24 shows the proportions of ferrous scrap and pig iron charged to iron and steel furnaces in 1939. Home or recycled scrap constituted approximately 26 percent of the total charge to steel furnaces and approximately 32 percent of the charge to iron furnaces. This has particular significance when iron and steel production figures are considered because ingot production is a yardstick for measuring activity in the steel industry. Yet it is usual for approximately one-fourth of the ingot production to remain in the steel plant as rotating working stock, or as home scrap, resulting from the various manufacturing processes.

Scrap materials are far more important to the iron and steel industry than is commonly realized. In 1939 the total iron and steel scrap consumed in the United States was equivalent to 121 percent of the iron content of all domestic and foreign iron ores and manganiferous ores used in blast furnaces. Purchased scrap alone used in that year was equivalent to 56 percent of the iron content of the ores. In 1937 these figures were 119 and 57 percent, respectively. In 1938 they were even higher, being 132 and 62 percent, respectively.[13]

During 1939 the iron and steel industry consumed 16,704,640 short tons of purchased scrap and 19,621,896 short tons of home scrap. Taking the average value of iron and steel scrap as $17.20 per gross ton at Pittsburgh, the total value of the scrap used in 1939 is estimated at $557,872,000. In addition to the iron and steel scrap, industry in general during 1939 consumed 419,500 short tons of new nonferrous scrap and 605,230 short tons of old nonferrous scrap having a combined value of $199,856,800.

These figures provide concrete evidence of the magnitude of scrap as a source of materials. They suggest, too, the importance of scrap materials to the conservation of our natural resources of ores. The value of the recovery of scrap materials to conservation of resources will increase in the future as the scrap industry grows and natural resources become depleted.

The widespread use of iron and steel scrap is indicated by the fact that all states contain plants that consume ferrous scrap materials. Table 25 shows the percent of total United States consumption of ferrous scrap and pig iron by States for 1939. This table indicates that a number of the scattered iron and steel plants are small and that the total amounts of scrap consumed in many of the States are of minor importance to the iron and steel industry as a whole. The greatest consumption of both ferrous scrap and pig iron was concentrated in the steel-making centers of the North Central, Middle Atlantic, and Southeastern areas. In fact, plants in eight States of these areas consumed 82 percent of the total ferrous scrap, 92 percent of the total pig iron, and 88 percent of the total iron and steel scrap and pig iron. These states and the percent of the total pig iron and scrap consumed in each for 1939 are: Pennsylvania 26, Ohio 21, Indiana 11, Illinois 8, Michigan 7, Alabama 5, New York 5, and Maryland 5. The plants in all the other States consumed only 8 percent of the total pig iron but 18 percent of the total ferrous scrap produced in the United States.

The small steel processing plants that consumed approximately 8 percent of the pig iron and 18 percent of the ferrous scrap in the United States in 1939 are good examples of establishments freed from original sources. Many of these plants are located in places at great distances from the raw steel producing centers or from sources of iron ore. The assertion is sometimes made that such small steel producing plants in the outlying areas are not material-oriented establishments. In reality they are so oriented, for they are located in respect to scrap iron and steel, which is their basic raw material, and to local fuel supplies.

Table 26 shows the total amount of ferrous scrap and pig iron consumed in each State and the percent of the total derived from home scrap, purchased scrap, and pig iron. It is evident from this table that establishments in the New England, Southwestern, and Pacific coast districts depend on scrap for the greatest percent of

TABLE 25.—*Percent of total consumption of ferrous scrap and pig iron in the United States, by states and districts, 1939*

State and district	Home scrap	Purchased scrap	Total scrap	Pig iron
Total United States:				
Gross tons	17,519,550	14,914,857	32,434,407	31,457.767
Percent	100.0	100.0	100.0	100.0
Connecticut	.5	.9	.6	.2
Maine	(1)	(1)	(1)	(1)
Massachusetts	.6	1.1	.9	.3
New Hampshire	(1)	(1)	(1)	(1)
Rhode Island	.1	.2	.2	.1
Vermont	(1)	.1	(1)	(1)
Total New England	1.2	2.3	1.7	.7
Delaware and New Jersey	1.1	2.1	1.6	.8
New York	4.8	5.3	5.0	5.1
Pennsylvania	23.9	20.5	22.3	28.8
Total Middle Atlantic	29.8	27.9	28.9	34.8
Alabama	3.8	3.5	3.7	6.8
District of Columbia, Kentucky, and Maryland	6.7	3.3	5.1	6.7
Florida and Georgia	.2	.6	.4	.2
Mississippi	(1)	(1)	(1)	(1)
North Carolina	.1	.2	.1	(1)
South Carolina	(1)	(1)	(1)	(1)
Tennessee and Virginia	.6	1.1	.8	.4
West Virginia	1.9	3.4	2.6	2.5
Total Southeastern	13.3	12.1	12.7	16.6
Arkansas, Louisiana, and Oklahoma	.1	.3	.2	(1)
Texas	.1	.4	.3	(1)
Total Southwestern	.2	.7	.5	(1)
Illinois	8.1	8.6	8.3	7.9
Indiana	12.0	10.6	11.3	10.9
Iowa	.3	.5	.4	.2
Kansas and Nebraska	.1	.3	.2	(1)
Michigan and Wisconsin	10.0	8.2	9.2	5.2
Minnesota	.5	.9	.7	.5
Missouri	.5	2.2	1.3	.1
North Dakota and South Dakota	(1)	(1)	(1)	(1)
Ohio	21.3	19.4	20.4	21.4
Total North Central	52.8	50.7	51.8	46.2
Arizona, Nevada and New Mexico	(1)	.1	.1	(1)
Colorado and Utah	1.1	1.6	1.3	1.2
Idaho	(1)	(1)	(1)	(1)
Montana	(1)	(1)	(1)	(1)
Wyoming	(1)	.0	(1)	(1)
Total Rocky Mountain	1.1	1.7	1.4	1.2
Alaska, Oregon and Washington	.2	1.0	.6	(1)
California	1.4	3.6	2.4	.5
Total Pacific Coast	1.6	4.6	3.0	.5

Source: *Minerals Yearbook, 1940*, p. 515.

[1] Less than 0.05 percent.

[13] *Minerals Yearbook, 1939* and *1940*.

TABLE 26.—*Total ferrous scrap and pig iron consumed and the percent of total derived from home scrap, purchased scrap and pig iron, by states and districts, 1939*

State and district	Total scrap and pig iron used (gross tons)	Percent of total used			
		Home scrap	Purchased scrap	Total scrap	Pig iron
Total United States	63, 892, 174	27.4	23.3	50.8	49.2
Connecticut	279, 014	28.3	45.2	73.5	26.5
Maine	17, 447	36.0	29.6	65.6	34.4
Massachusetts	372, 014	27.2	45.1	72.3	27.7
New Hampshire	6, 883	45.5	30.8	76.3	23.7
Rhode Island	80, 516	26.2	44.7	70.9	29.1
Vermont	17, 777	24.8	42.4	67.2	32.8
Total New England	773, 651	27.8	44.5	72.3	27.7
Delaware and New Jersey	764, 006	25.3	41.8	67.2	32.8
New York	3, 245, 709	25.7	24.3	50.0	50.0
Pennsylvania	16, 304, 935	25.7	18.7	44.4	55.6
Total Middle Atlantic	20, 314, 650	25.7	20.5	46.2	53.8
Alabama	3, 318, 303	20.3	15.7	36.0	64.0
District of Columbia, Kentucky, and Maryland	3, 767, 044	31.0	12.9	43.9	56.1
Florida and Georgia	178, 836	21.2	48.0	69.2	30.8
Mississippi	2, 917	24.5	64.4	88.9	11.1
North Carolina	48, 368	25.3	49.1	74.4	25.6
South Carolina	7, 702	26.5	47.4	73.9	26.1
Tennessee and Virginia	401, 960	24.5	42.0	66.6	33.4
West Virginia	1, 619, 613	20.1	31.4	51.5	48.5
Total Southeastern	9, 344, 743	24.8	19.3	44.1	55.9
Arkansas, Louisiana, and Oklahoma	61, 564	19.1	78.0	97.1	2.9
Texas	90, 586	26.3	71.2	97.5	2.5
Total Southwestern	152, 150	23.4	73.9	97.3	2.7
Illinois	5, 177, 788	27.4	24.8	52.2	47.8
Indiana	7, 103, 680	29.5	22.3	51.9	48.1
Iowa	188, 616	33.7	40.3	74.0	26.0
Kansas and Nebraska	62, 602	24.3	70.7	95.0	5.0
Michigan and Wisconsin	4, 621, 446	38.0	26.3	64.3	35.7
Minnesota	382, 381	22.1	34.5	56.6	43.4
Missouri	452, 756	20.4	72.2	92.6	7.4
North Dakota and South Dakota	2, 229	64.9	29.2	94.1	5.9
Ohio	13, 369, 993	27.9	21.6	49.5	50.5
Total North Central	31, 361, 491	29.5	24.1	53.6	46.4
Arizona, Nevada, and New Mexico	23, 091	29.5	70.3	99.9	.1
Colorado and Utah	787, 845	24.1	29.2	53.3	46.7
Idaho	2, 315	8.3	90.8	99.1	.9
Wyoming	3	66.7	0	66.7	33.3
Montana	5, 995	50.8	45.0	95.8	4.2
Total Rocky Mountain	819, 249	24.4	30.6	55.0	45.0
Alaska, Oregon, and Washington	182, 752	19.8	77.1	96.9	3.1
California	943, 488	26.2	57.3	83.5	16.5
Total Pacific coast	1, 126, 240	25.2	60.5	85.7	14.3

Source: Based on data in *Minerals Yearbook, 1940.*

their ferrous raw materials. This is also true of establishments in many States in the other districts. Apparently scrap constitutes by far the greater part of the ferrous raw materials used in States other than the so-called iron and steel-producing States. For example, observe the statistics for the States in the North Central iron and steel district. In that district scrap is the chief raw material for establishments in Iowa, Kansas, Nebraska, Missouri, and the Dakotas.

Even though the total amount of ferrous scrap consumed in the majority of States is only a small fraction of the total scrap and pig iron consumed in the United States, the small scattered steel plants have a special locational significance (Table 25). The pull on industry of available scrap materials is toward consumption areas and processing areas, for it is in those areas that most scrap materials become available in the form of discarded consumer articles or industrial by-products. The availability of scrap materials tends to decrease the connection between location of manufacturing and sources of primary raw materials.

Foreign Sources of Materials

The very large and complex industrial system of the United States requires large quantities of raw materials. Many of these must come from foreign lands because domestic resources are lacking or have not yet been discovered or exploited. Even where there are domestic resources, some raw materials come from foreign lands because it is more economical to purchase certain supplies than to develop or to process the domestic materials. A good example of this is bauxite, the ore from which aluminum is manufactured. In 1939 only 48 percent of the bauxite consumed in the United States was produced here, the remainder having been imported. Other examples of this type are copper, gypsum, and pyrites. Either because of a lack of domestic resources or because of convenience, the United States has become dependent on foreign sources for some materials.

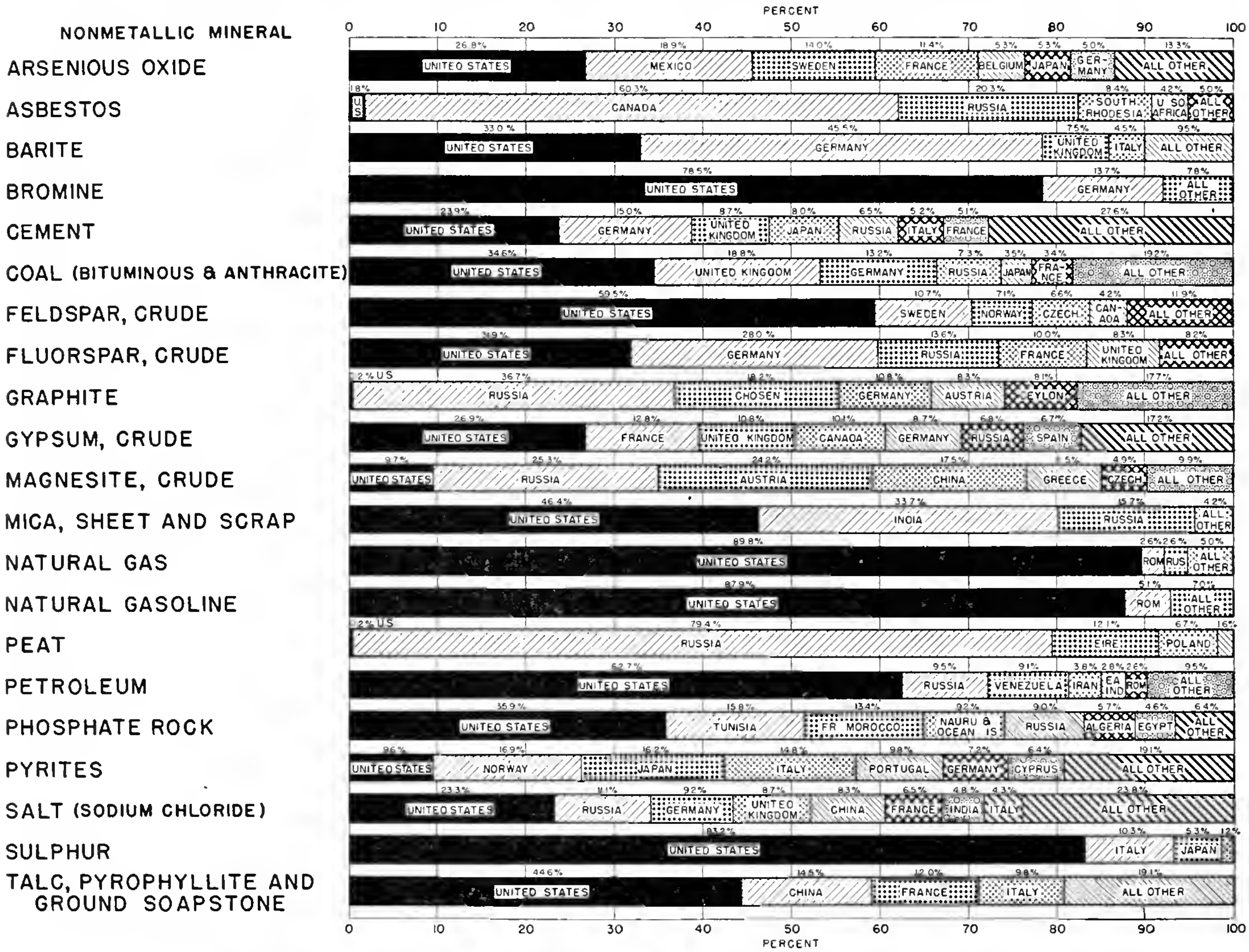
It is interesting to note the position of the United States in respect to the production of crude, or raw, materials. Figures 59 and 60 show the proportion of the world's production of the various metals and nonmetals, respectively, in the United States and in leading foreign producing areas.

Among the metals, the United States leads as a producer in the world's supply of copper, iron, lead, zinc, and molybdenum ores; among the nonmetallic minerals, in arsenious oxide, bromine, cement, coal, crude feldspar, crude fluorspar, crude gypsum, mica, natural gas, natural gasoline, petroleum, phosphate rock, salt (sodium chloride), sulfur, talc, pyrophyllite, and ground soapstone. The statistics on the proportion of production of the various minerals present a far different picture than do those on the proportion of the world's minerals consumed in the United States. Data on consumption of minerals are more common, and these sometimes give the impression that the United States is self-sufficient in nearly all materials.

Table 27 shows the proportion of the world's minerals produced and the percent consumed in the United States. Similar statistics for foreign areas[14] indicate that the United States is by far the world's greatest consumer, having the leading position as consumer for nearly every mineral. In those cases where the United States is not the leading consumer the explanation

[14] Brooks Emeny, *The Strategy of Raw Materials*, New York, 1936, pp. 12–25.

PERCENT OF WORLD PRODUCTION OF SELECTED NONMETALLIC MINERALS
UNITED STATES AND LEADING FOREIGN PRODUCERS, 1937 1/



SOURCES: BASED ON DATA FROM BUREAU OF MINES, MINERALS YEARBOOK, 1938, 1939, AND 1940; STATISTICAL YEARBOOK OF THE LEAGUE OF NATIONS, 1939-1940 (GENEVA); AND IMPERIAL INSTITUTE, THE MINERAL INDUSTRY OF THE BRITISH EMPIRE AND FOREIGN COUNTRIES, STATISTICAL SUMMARY, 1936-1938 (LONDON).

1/ THE PER CENT CALCULATIONS ARE BASED ON STATISTICS FOR THE PRODUCTION OF PRIMARY MINERALS NOT INCLUDING STATISTICS ON THE RECOVERY OF SECONDARY MINERALS.

PREPARED IN OFFICE OF THE NATIONAL RESOURCES PLANNING BOARD

FIGURE 59

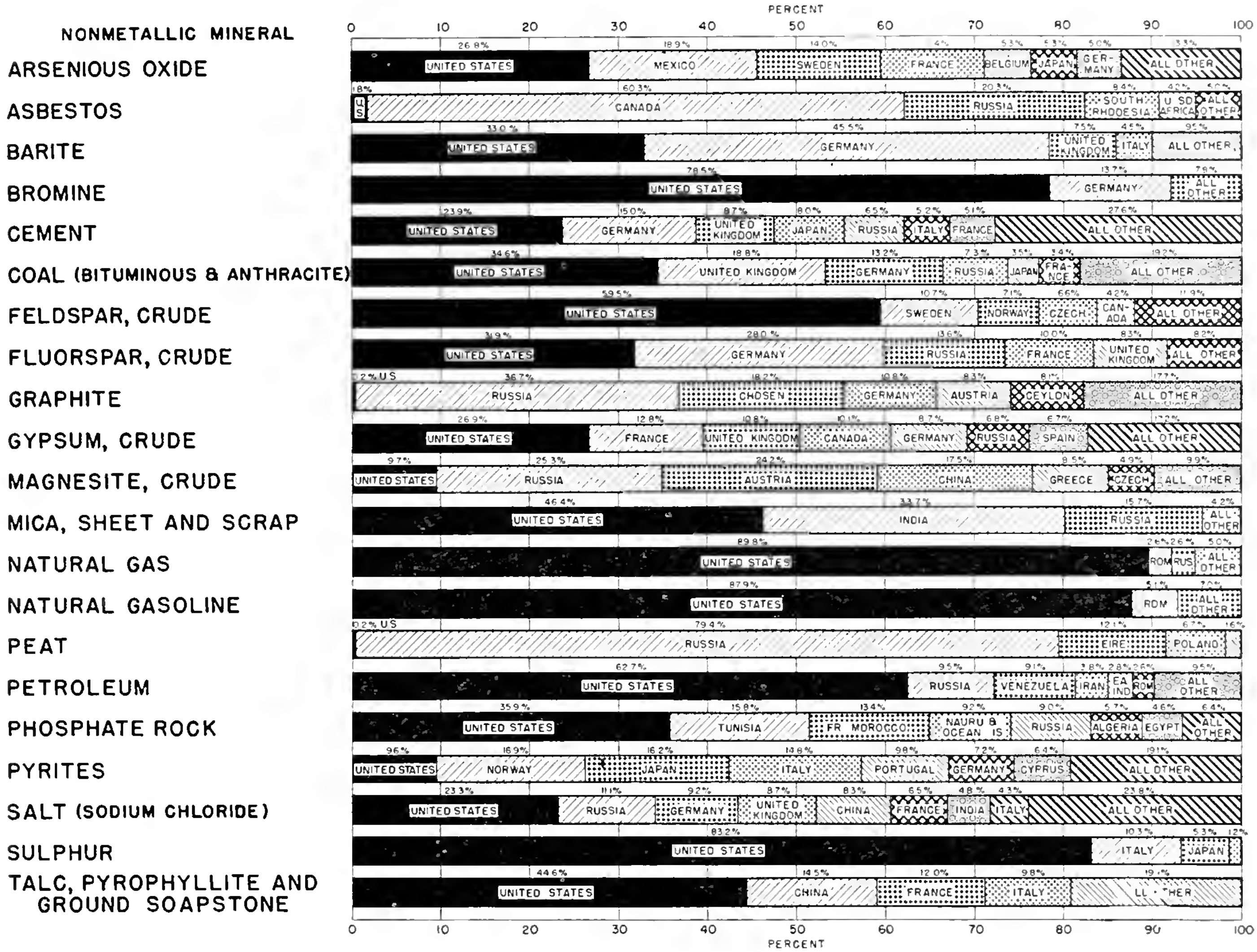
can usually be found in substitutes that are available domestically. A good example of a mineral of this type is peat. The United States consumed 138,094 short tons or only 0.6 percent of the world's peat in 1937. Of this amount, 51,223 short tons were produced domestically.[15] The known peat reserves available in the United States are extensive. These have been estimated to be 13,827,000,000 short tons of equivalent air-dried peat.[16] In the United States peat is used primarily for soil improvement and there are numerous possible substitutes in the form of humus, organic matter, and other fertilizers available in large quantities to compete with peat on the domestic market. Another reason for our apparent low proportion of the world's consumption is that even though peat is used as a fuel in many European countries, particularly in Eire, its use for that purpose is practically negligible in this country because of the large supplies of higher-grade fuels obtainable at reasonable costs. Similar reasons account for our low proportion of the world's consumption of pyrites, crude magnesite, and metallic magnesium.

Except for pyrites, peat, magnesite, manganese ore, graphite, and metallic magnesium, the United States consumed in 1937 more than one-fifth of the world's production of each of the important types of minerals (cf. table 27). Furthermore the over-all consumption

[15] Bureau of Mines, *Minerals Yearbook, 1939.*

[16] Soper, E. K., and Osbon, C. C., *The Occurrence and Uses of Peat in the United States*, Geological Survey Bulletin No. 728, 1922, p. 92.

PERCENT OF WORLD PRODUCTION OF SELECTED NONMETALLIC MINERALS UNITED STATES AND LEADING FOREIGN PRODUCERS, 1937 1/



SOURCES: BASED ON DATA FROM BUREAU OF MINES, MINERALS YEARBOOK, 1938, 1939, AND 1940; STATISTICAL YEARBOOK OF THE LEAGUE OF NATIONS, 1939-1940 (GENEVA); AND IMPERIAL INSTITUTE, THE MINERAL INDUSTRY OF THE BRITISH EMPIRE AND FOREIGN COUNTRIES, STATISTICAL SUMMARY, 1936-1938 (LONDON).

1/ THE PER CENT CALCULATIONS ARE BASED ON STATISTICS FOR THE PRODUCTION OF PRIMARY MINERALS NOT INCLUDING STATISTICS ON THE RECOVERY OF SECONDARY MINERALS.

PREPARED IN OFFICE OF THE NATIONAL RESOURCES PLANNING BOARD

FIGURE 60

demands of industries in the United States almost equaled the demands of the rest of the world combined.

Table 27 also shows the ratio of production to consumption of the various minerals. Less than 100 percent indicates insufficient production of the mineral for consumption demands; percents greater than 100 indicate that the United States produced a surplus and may export quantities of that material. For example, the ratios for tin, nickel, chromite ore, and graphite are almost zero, indicating that nearly all of the supplies of these minerals were imported in 1937. Other low ratios of production to consumption indicate that the United States imported fairly large proportions of antimony ore, bauxite, columbium and tantalum ores, manganese ore, mercury, platinum metals, tungsten ore, vanadium, arsenious oxide, and asbestos. On the other hand, high ratios indicate that the United States had substantial exportable surpluses of molybdenum, phosphate rock, and sulfur. It is interesting to note that supplies of certain minerals such as iron ore and zinc are imported although the United States is the leading producer of these minerals and probably has the world's largest deposits. The explanation for this importation may be found in the quality or economies inherent in certain foreign ores.

The United States leads the world in production of mica and also imports large quantities. This mineral deserves special mention when considering supplies

of materials for the electrical machinery, equipment, and apparatus industries. In spite of a large domestic production of mica, the United States has been almost wholly dependent on foreign sources, especially British India, for supplies of mica splittings of all kinds, radio tube mica, condenser shot mica, "cigarette" mica, and other mica specialties. It is only from block or book mica that it is possible to produce the high-grade mica specialties needed in electrical machinery manufacturing, armament manufacturing, and communication industries. These special kinds of mica are almost completely lacking among the domestic resources, or are too expensive to recover. Domestic mica, however, has been produced in ample quantities to supply industrial needs for most of the ordinary uses.

Material supplies are one of the primary reasons for the interdependence of nations, as well as of subnational areas. There are a few mineral resources whose distribution is exceedingly concentrated. For example, the world is primarily dependent on India for supplies of high-grade block mica; on Germany for potash; on Russia, India, and South Africa for manganese; and on relatively few areas for tin, nickel, platinum metals, chromite, antimony, sulfur, phosphate, and mercury.

Because of problems of supply, certain materials imported into the United States have been designated as strategic and critical materials by the Commodities Division of the Army and Navy Munitions Board.[17]

Strategic materials are those essential to national defense, the supply of which in war would have to be drawn in whole or in substantial part from sources outside the continental limits of the United States, and for which strict conservation and distribution control measures would be necessary. There are 14 materials as follows, in this list:[18]

Antimony.	Nickel.
Chromium.	Quartz crystal.
Coconut shell char.	Quinine.
Manganese, ferrograde.	Rubber.
Manila fiber.	Silk.
Mercury.	Tin.
Mica.	Tungsten.

Critical materials are those essential to national defense, the procurement problems of which in war would be less difficult than those of strategic materials either because they have a lesser degree of essentiality or are obtainable in more adequate quantities from domestic sources, and for which some degree of conservation and distribution control would be necessary. The following 15 materials are included in this list:[19]

Aluminum.	Optical glass.
Asbestos.	Phenol.
Cork.	Platinum metals.
Graphite.	Tanning materials.
Hides.	Toluol.
Iodine.	Vanadium.
Kapok.	Wool.
Opium.	

TABLE 27.—*Share of world production and consumption and ratio of production to consumption of selected minerals in the United States, 1937* [1]

[Based on physical volume]

	Percent of world production	Percent of world consumption[2]	Percent ratio of production to consumption [2]
Metallic minerals:[3]			
Antimony ore [4]	3.0	43.2	7.0
Bauxite [5]	11.5	20.3	59.6
Chromite ore [4]	.2	44.1	.5
Columbium and tantalum ores	1.0	63.0	1.7
Copper	32.8	28.8	121.0
Gold	11.6	(6)	(6)
Iron ore	34.7	35.3	98.4
Lead	25.2	23.4	103.9
Maguesium	10.4	10.4	100.0
Manganese ore [4,7]	.7	16.1	4.2
Mercury [4]	12.6	26.8	47.2
Molybdenum	91.9	36.8	249.8
Nickel [4]	.2	37.6	.5
Platinum metals [5,8]	4.5	21.7	20.2
Silver	25.7	(6)	(6)
Tin [4]	.1	43.5	.2
Tungsten ore [4]	8.4	20.5	41.0
Vanadium [5]	25.3	54.6	46.3
Zinc	30.4	31.9	97.1
Noumetallic minerals:			
Arsenious oxide	26.8	57.2	48.4
Asbestos [5]	1.8	46.5	3.8
Barite	33.0	38.4	94.0
Bromine	78.5	81.5	96.3
Cement	23.9	23.7	100.8
Coal (bituminous and anthracite)	34.6	32.5	106.7
Feldspar, crude	59.5	60.0	95.5
Fluorspar, crude	31.9	33.9	93.6
Graphite [5]	.2	11.5	1.9
Gypsum, crude	26.9	34.8	77.3
Magnesite, crude	9.7	12.6	77.4
Mica, sheet and scrap [4]	46.4	56.1	82.7
Natural gas	89.8	89.8	100.1
Natural gasoline	87.9	81.4	108.1
Peat	.2	.4	37.1
Petroleum	62.7	60.8	103.2
Phosphate rock	35.9	26.5	135.6
Pyrites	9.6	17.6	52.7
Salt (sodium chloride)	23.3	23.2	100.3
Sulfur	83.2	53.9	154.2
Talc, pyrophyllite and ground soapstone	44.6	48.1	92.7

Sources: U. S. Bureau of Mines, *Minerals Yearbook*, 1938, 1939, and 1940, Washington; *Statistical Yearbook of the League of Nations, 1939–40* Geneva, 1940: Imperial Institute, *The Mineral Industry of the British Empire and Foreign Countries, Statistical Summary, 1936–38*, London, 1939.

1 The calculations in this table are based on statistics for the production and apparent consumption of primary minerals not including statistics on the recovery or consumption of secondary minerals.

2 Calculations are based on apparent consumption. When reported consumption figures were not available, the world consumption was taken as equal to the world production of the particular mineral and the United States consumption was considered as the domestic production plus the difference between imports and exports of the mineral.

3 Metal content of ores is used as base except where ores are indicated. Ores are used as the base only for those minerals in which the quality of the ore is fairly uniform in all the producing areas.

4 Listed as a strategic mineral by the Army and Navy Munitions Boards.

5 Listed as a critical mineral by the Army and Navy Munitions Boards.

6 Calculations not shown for gold and silver. Apparent consumption of these metals is not strictly comparable to that for others because of the large amounts of gold and silver retained or transferred from storage for monetary uses.

7 Does not include ferruginous manganese ores, manganiferous ores, or manganiferous zinc ores.

8 Includes platinum, iridium, osmium, osmiridium, palladium, rhodium, and ruthenium.

17 Army and Navy Munitions Board, *The Strategic and Critical Materials*, March 1940 (mimeographed). Subsequently other materials have been designated by the Army and Navy Munitions Board or by the President as strategic and critical for procurement purposes only.

18 Ibid.

19 Ibid.

TABLE 28.—*Value and percent distribution of principal general commodities imported for consumption, United States, 1939*[1] *(ranked in order of value within major commodity groups)*

Commodity	Value (thousands of dollars)	Percent of grand total	Percent of group total
Total, all imports for consumption	2,276,099	100.0	....
Crude materials, except foodstuffs, total	741,860	32.7	100.0
Crude rubber, all grades	180,926	7.9	24.3
Raw silk	120,852	5.3	16.2
Undressed furs	49,759	2.2	6.7
Unmanufactured wool and mohair	49,637	2.2	6.7
Crude metals and ores	47,420	2.1	6.4
Raw hides and skins (except furs)	47,057	2.1	6.3
Tobacco leaf and stems	36,918	1.6	5.0
Flaxseed, copra, and other oilseeds	33,182	1.5	4.4
Cotton, sisal, and other vegetable fibers	31,912	1.4	4.3
Crude petroleum	23,289	1.0	3.1
Precious stones	17,811	.8	2.4
Pulpwood, logs, and unmanufactured wood	17,603	.8	2.4
Nonmetallic minerals, not elsewhere specified	14,936	.6	2.0
Gums, resins, and balsams	11,949	.5	1.6
Herbs, leaves, roots, and crude drugs	10,985	.5	1.5
Fertilizer materials	7,026	.3	.9
Other crude materials	43,594	1.9	5.8
Crude foodstuffs and food animals, total	290,840	12.8	100.0
Coffee	139,546	6.1	48.0
Bananas	29,083	1.3	10.0
Cocoa or cacao beans	27,613	1.2	9.5
Tea	21,090	.9	7.3
Cattle	20,207	.9	6.9
Fruits and nuts, except bananas	14,331	.6	4.9
Spices	12,504	.6	4.3
Fresh or frozen fish	11,906	.5	4.1
Wheat and other grains	8,256	.4	2.8
Other crude foodstuffs	6,303	.3	2.2
Semimanufactures, total	486,766	21.4	100.0
Paper base stock (pulp)	75,922	3.3	15.6
Tin	70,591	3.1	14.5
Copper	40,704	1.8	8.4
Vegetable oils, extracted	34,324	1.5	7.0
Precious stones (not set)	32,402	1.4	6.6
Nickel	25,225	1.1	5.2
Sawmill and wood products	24,391	1.1	5.0
Metals and alloys, not elsewhere specified	23,846	1.1	4.9
Fertilizers	23,834	1.0	4.9
Yarns and other textile semimanufactures	23,428	1.0	4.8
Leather, dressed furskins, and bristles	22,243	1.0	4.6
Petroleum products	19,302	.9	4.0
Coal-tar dyes and other coal-tar products	18,336	.8	3.8
Industrial chemicals	15,326	.7	3.1
Nonmetallic minerals, not elsewhere specified	9,549	.4	2.0
Asbestos	7,222	.3	1.5
Other semimanufactures	20,128	.9	4.1
Manufactured foodstuffs and beverages, total	313,336	13.8	100.0
Cane sugar	124,649	5.5	39.8
Alcoholic beverages	57,333	2.5	18.3
Meats and meat products	28,729	1.3	9.2
Fish and other prepared sea foods	20,498	.9	6.5
Fruit and nut preparations	14,802	.6	4.7
Cheese	12,844	.6	4.1
Vegetable preparations	12,420	.5	4.0
Fodders and feeds	10,953	.5	3.5
Vegetable oils and fats	10,712	.5	3.4
Molasses	8,203	.4	2.6
Other manufactured foodstuffs	12,192	.5	3.9
Finished manufactures, total	440,297	19.3	100.0
Textile manufactures	131,654	5.8	29.9
Newsprint and other paper manufactures	126,783	5.6	28.8
Art works	17,589	.8	4.0
Machinery and vehicles	15,095	.7	3.4
Lathes, shingles, and other wood products	12,503	.5	2.8
Clocks, watches, and jewelry	12,218	.5	2.8
Iron and steel mill products	11,602	.5	2.6
Chemicals and related products	10,218	.4	2.3
Books, maps, and other printed matter	9,116	.4	2.1
Photographic goods	7,899	.3	1.8
Household and personal effects, not for sale	6,925	.3	1.6
Clay products	6,834	.3	1.5
Leather manufactures	6,528	.3	1.5
Other finished manufactures	44,750	2.0	10.2
U. S. products exported and returned	20,583	.9	4.7

[1] General merchandise imports for consumption do not include imports of gold and silver ore, sweepings, bullion, or coin. The imports of gold in 1939 were valued at $3,574,659,000; of silver at $85,307,000.

Source: Value data compiled from U. S. Department of Commerce, *Foreign Commerce and Navaigation of the United States, 1939.*

The strategic and critical material lists are subject to change as it becomes necessary to add new materials or possible to drop some that are already on the list. Discoveries of new sources, or development of substitutes, may remove the dependency on a given material. Once shellac, camphor, nitrates, and other materials were on the list, but scientific developments have removed dependence on foreign sources for these substances. There is a possibility that silk, coconut shell char, mica, and perhaps a few others on the list may be removed because of scientific developments.

Due principally to their compactness, their small proportion of total product in most cases, and their use in conjunction with domestic materials, the strategic and critical materials as a group have had only a minor influence on the location of industry. Probably the strongest pull has been exerted by importation of wool and hides, a factor that has been favorable to location along the Atlantic seaboard and especially in New England.

Certain other foreign materials not on the list of strategic or critical materials, either because of adequate domestic supplies or because of lack of direct applicability for defense, do have decided locational significance. Overseas imports of sugar, crude petroleum, iron ore, and copper have attracted industry to coastal locations, the main concentrations being at the eastern edge of the manufacturing belt. For some manufacturing using imported materials to produce for the export trade, inland locations would be disadvantageous.

A few materials, for example, crude petroleum, are imported into certain areas and exported from others. Qualitative factors may partially explain this concurrent inflow and outflow of materials. An extreme example is the shipment of rags for paper stock. High-grade rags are on occasion imported, and low-grade rags exported on the same ships over the same routes. Where this qualitative factor is not present, one area may receive materials from abroad and another area may export them because of competing locational influences similar to those which operate domestically.

The value of the principal commodities imported for consumption in the United States in 1939 is shown in table 28. Those of special importance to location of industry are the crude materials and the semimanufactures. The manufactured foods, beverages, and finished commodities, except possibly such goods as cane sugar, burlaps, and a few other textile manufactures, are largely competitors of products of domestic industries. A chief attraction for the movement of such goods to an industrial area is the proximity of markets through cheap water transportation. On the other hand, almost all of the important crude materials

and semimanufactures are imported because of domestic deficiencies in resources, or because of the necessity of obtaining certain materials from foreign sources during off-season periods. Crude materials, including crude foodstuffs, comprise almost one-half of the value of imports. Of these, rubber, silk, raw furs, raw wool, coffee, bananas, cocoa beans, and tea are the principal goods. Wood pulp, tin, diamonds, copper, and vegetable oils such as tung oil, coconut oil, and palm oil are the important semimanufactures. Domestic resources of all these, except possibly wood pulp and copper, are deficient and in some cases are completely lacking. The principal imported raw materials exert an influence on the location of the silk, woolen goods, rubber goods, leather goods, and vegetable oil processing industries. A large proportion of such industries conduct their activities within reasonably close distances of their major markets and principal ports of material supply. And generally establishments of these industries are located on the fringes of their markets toward the part of the seacoast having a port of entry.

Balancing of Requirements

Some industries concentrate near sources of raw or semimanufactured materials, others are located primarily with reference to marketing, and still others show a tendency to locate near power sources or reserves of skilled labor. The increased mobility of production factors in the modern industrial system, however, has relaxed the ties of industry with materials, markets, power, or labor so that outright examples of industries located because of any one of these factors alone are few in number.

With respect to materials the industrial economy is characterized by the large volume of consumption, by the considerable number of intermediate stages of production, and by the increasing availability of materials in nearly all areas. This latter factor is being solved to such an extent by modern transportation facilities that for many materials the effective radius of supply has been extended sufficiently to remove much of the importance of locating industry very close to basic sources.

Because of their production by complex processes, consumer commodities lose much of their identification with original material sources. This, however, is still not unqualifiedly true for all industries, for there are certain basic industries which remain to a considerable extent tied to sources of materials. Examples of these are steel, lumber, glass, nonferrous metal smelting, and grain milling industries.

The location of basic industries in turn exercises a strong influence on the location of many service industries. Often complete and important industrial areas grow in a given locality because of the location of one or more important basic manufacturing industries. The manufacturing activity itself in such areas plays the most active role in determining locational patterns and in determining in part which of several alternative locations of resources are to be used.

The 68 principal raw-material-consuming industries considered earlier in this chapter have a common characteristic in that such industries usually are distributed in proximity to their raw materials. Thus a map of the areas producing lead ores corresponds somewhat closely to a map showing the location of lead smelters; a map of the principal dairy areas indicates also the location of creameries, of cheese plants, and of condensed milk establishments; a map of cotton fields defines roughly the locations of cotton seed oil, cake, and meal plants; and a map of the principal forest areas indicates in some degree the locations of pulp mills and sawmills. In each case the concentration of manufacturing is proportional to the importance of the raw-material-producing area, for the plants draw their raw materials from a suitably large source.

Iron ore, coal, and a few of the more abundant nonferrous ores, because of the tremendous quantities consumed, seem to be the minerals of greatest importance to location. The other minerals, for example, stone and sand, are either so widespread that industries using them do not require special locations near the major regions of their occurrences, or the proportion of their use with other materials is so small that they are important only within very wide cost limits. Raw forest materials, because of their heavy physical volume and great loss of weight in processing, usually attract first-stage manufacture to their sources. Some agricultural products show a similar tendency. Thus, milling establishments are often close to the principal grain producing areas. The same is true of meat packing establishments, but to a lesser extent, for they tend to balance the advantages of both nearness to sources of live animals and nearness to markets. The canning and preserving of sea foods is nearly always completed very close to shore. In this case, as in the canning and preserving of fruits and vegetables, the perishable nature of the raw commodity usually forces the location of the processing establishment close to the source.

It has been indicated that only part of the manufacturing industries must locate near sources of raw materials, such as mineral ores, and that only approximately 20 percent by number of the manufacturing industries defined by the Bureau of the Census have a prime interest in such locations. These industries,

however, often exert much influence on other manufacturing industries through assembly of semimanufactured materials. There is considerable evidence that certain consumers of semimanufactured materials may locate close to the center of smelting, refining, and initial processing of the crude ores of the metal in which they are especially interested. Most of the heavy machinery and castings, for example, are produced in establishments located near blast furnaces. This tendency may result in the growth of an industrial area in and about the smelting center, as the basic industry and the semimanufacturing processors dependent on it attract various auxiliary industries. Not all producers of heavy iron and steel machinery, however, locate near blast furnaces. Problems of transportation to markets or other factors may cause the industry to locate elsewhere, sometimes at a considerable distance from the chief sources of semimanufactured material. The agricultural implement industry and branch assembly plants of the automobile industry have been cited as examples.

Economies in the utilization of materials and advances in transportation have done much to reduce or even eliminate the necessity for users of semimanufactured materials to locate near their chief sources of materials. Preparation of semimanufactured materials to meet precise specifications enables manufacturers using such materials and having complicated mass production systems to obtain an uninterrupted flow of materials conforming to acceptable standards. Furthermore, many materials are made available in such form that there is minimum or no weight loss in the final processing stages. It makes little difference whether an industrial establishment using such materials is located at the source of materials or at the most convenient marketing point if the costs of moving finished products and of moving the materials are approximately the same.

Modern developments in making electric power available over widespread areas and in producing fuels which are relatively inexpensive to transport have reduced the dependence of industries on fuel sources. Since required materials have become so easy to obtain, standardize, and manage, modern manufacturers have become far more concerned with other problems such as labor supply and application of craft skill to machines. Improvements in the utilization and assembly of materials, fuels, and power, then, tend to decrease the locational importance of extractive areas and to increase the importance of the market. In addition, technological changes have facilitated the development of complex industries using many materials and producing a variety of products. Because the assembly and use of many different materials in one establishment decreases the relative importance of any one material, other factors in such cases tend to outweigh problems of location in respect to any one raw or semimanufactured material.

It has been demonstrated that sources of raw materials commonly are important factors influencing the location of those industries which are predominantly raw-material consumers. Such industries are likely to consume one or two dominant materials, a typical case being a raw material proper and a fuel; the locational attraction is likely to be reinforced by such factors as weight loss, perishability, and impossibility of substitution of materials. Industries operating in later stages of manufacture, even though they consume mainly a single material and produce only a single product, are usually more strongly influenced by consumption centers than raw-material-consuming industries. Industries which consume a variety of semimanufactures pursue their activities as a rule in areas where there is access to byproducts of other industries, to partly fabricated products, to equipment, and to markets.

CHAPTER 7. POWER AND FUELS

By Lincoln Gordon*

The influence of energy resources on industrial location is in general similar to that of other materials entering into industrial processes, but several features peculiar to power and fuel give them special locational significance which warrants separate analysis.

The resources considered in this chapter are coal, oil, natural and manufactured gas, and electric energy. The latter may be produced by one of the fuels, or may be hydraulically generated. It is evident that coal, oil, and gas may be employed as raw materials in the narrow sense, rather than as sources of energy (thermal or otherwise). Thus, in the smelting of iron ore, coke made from coal is used as a reducing agent as well as a fuel, while in the manufacture of carbon black, natural gas is used as a raw material. In some instances, utilization as fuel is inseparably intertwined with utilization as material. The locational influence of a given material does not depend upon the nature of its utilization, but it is important to note that as sources of energy the materials here treated may be readily substituted for one another over a wide range, while as raw materials substitution is generally more difficult or impossible.

The special locational characteristics of power and fuel are threefold. In the first place, all the energy resources except coal are transported in whole or in part by special methods peculiar to themselves. Pipe lines for oil and gas, and high-tension transmission lines for electric energy, follow a geographical pattern differing from the network of railways, waterways, and highways over which most raw materials are carried; this results in an unusual structure of transportation costs and charges. The peculiarities are particularly striking in the transmission of electricity, where geographical variations in rates are based less upon the combined costs of generation and transmission than upon the nature of the load and the rate policies of particular utility systems.

Secondly, in their industrial uses, the energy resources often compete with one another and may be substituted one for another. For general heating purposes, coal, crude or fuel oil, and natural gas are all widely employed; for carefully controlled heating, electricity and gas (natural or manufactured) each has its special advantages; for electricity generation, water power, steam (raised from coal, oil, or gas) and internal combustion engines (gasoline or Diesel) all play a part. The locational influence of power and fuel, therefore, must be analyzed in terms of the energy resources viewed as an interrelated whole.

In the third place, fuel and power are wholly consumed in the process of manufacture, and consequently, unlike most raw materials, do not enter into the weight of the manufactured product. Moreover, transportation costs of coal, oil,[1] and natural gas constitute a relatively high proportion of the delivered price, while zones of low-priced electric power are relatively narrow. Geographical variations in fuel and power costs are therefore very large. Although other factors often must be considered, heavy consumers of fuel or power tend to be locationally oriented toward low-cost power or fuel areas.

Power and Fuel as Locational Factors in Manufacturing Industries

The analysis in this chapter is confined to manufacturing industries. Fuel and power play a negligible role in the costs of distributive industries, which are in any case necessarily market-oriented. The extractive industries, while often consuming substantial quantities of energy, are bound to their sources of supplies. Only rarely would the selection of alternative mining sites be dictated by considerations of energy cost, since this factor is ordinarily insignificant by comparison with extraction costs, adequacy of transportation facilities, and relation to the market. The only other important industrial consumers of fuel and power not now classified by the Bureau of the Census among "manufactures" are the public utilities engaged in energy conversion—gas manufacturing[2] and electric light and power. Limitations on transportation of manufactured gas and electric energy tend to orient these industries toward the market, although in the latter case, generating plants are sometimes placed at a substantial distance from metropolitan consuming centers in order to take advantage of low-cost mine-mouth fuel or cheap water power.

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[1] An exception should be noted for the case of tanker transportation of oil, which under normal conditions is very cheap.

[2] The manufactured-gas industry was included in the *Census of Manufactures* until 1935, but subsequently eliminated. It has been excluded for all years in the comparative data presented in this chapter.

ENERGY CONSUMPTION IN MANUFACTURING INDUSTRIES, 1909 - 1939
(BITUMINOUS COAL OR EQUIVALENT)

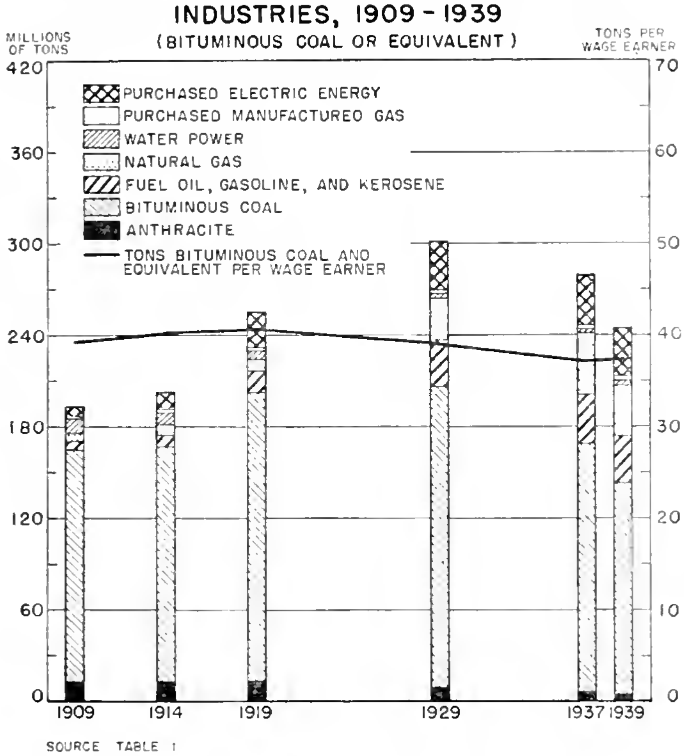

FIGURE 61

Physical Consumption

Data on physical quantities of energy consumption are available only back to 1909. The salient facts in those years for which census information was assembled are condensed in table 1 and figures 61 and 62. Total energy consumption rose gradually in the pre-World War I period, became rapidly accelerated during the war, reached its peak in 1929, and has subsequently fallen off substantially. It must be remembered that these figures represent merely energy consumed, rather than energy effectively delivered into manufacturing processes. Efficiency of fuel conversion, particularly in the case of coal, has enormously increased over the past quarter century.[3] In steam-electric stations, fuel consumption per kilowatt-hour generated fell from 6.2 pounds in 1902 to 3.5 pounds in 1917 and 1.39 pounds in 1939. Although these dramatic savings were not fully matched in other areas, coal consumption per unit volume of manufactured gas fell 33 percent between 1909 and 1939, while in coke manufacture coal consumption per ton fell 5.5 percent during the same period. In the years since the first World War, coke consumption per ton of pig iron has been reduced by one-fifth.

It is not unreasonable to estimate the over-all improvement in efficiency of fuel consumption in manufactures over the past two decades in the neighborhood of 50 percent. Thus the 8-percent reduction in energy consumption per wage earner between 1919 and 1939 took place despite a probable increase of almost 40 percent in the effective energy delivered per wage earner. So far as effect on industrial location is concerned, attention must of course be focused upon the actual quantities of energy resources consumed, regardless of improvements in conversion efficiency. In this connection, however, the reversal in 1937 of the downward trend in total consumption per wage earner, and the restoration of the upward tendency obtaining before 1919, suggests a tapering off in the rate of

PROPORTION OF EACH ENERGY SOURCE TO TOTAL ENERGY CONSUMED IN MANUFACTURING INDUSTRIES, 1909 - 1939
(ALL SOURCES REDUCED TO BITUMINOUS COAL EQUIVALENT)

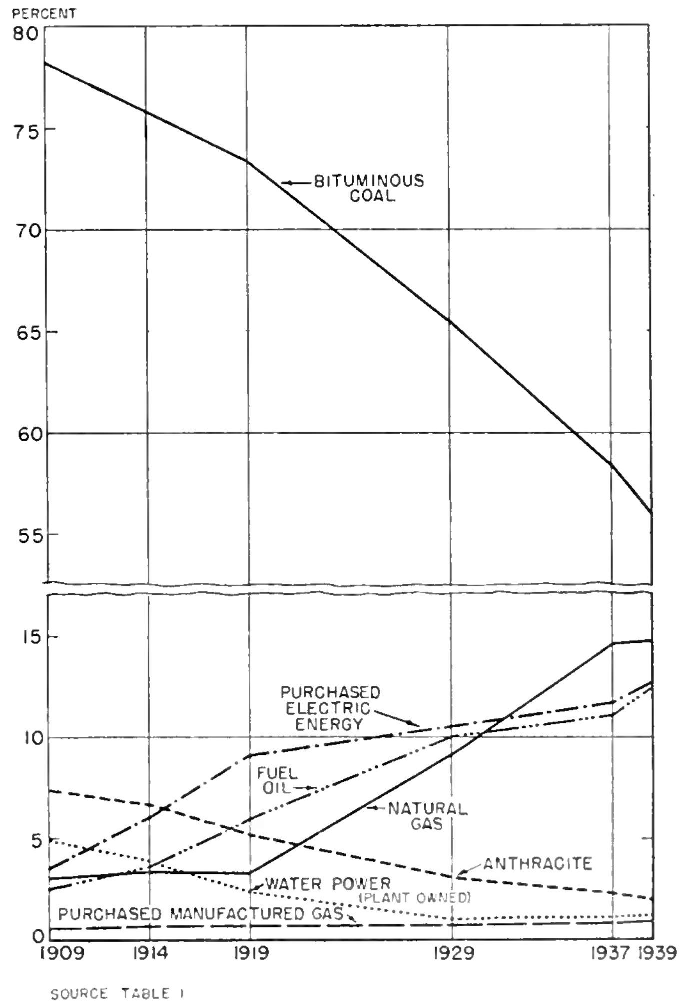

FIGURE 62

[3] Statistics on some aspects of improved fuel consumption efficiency are presented annually in the bituminous coal chapter of the *Minerals Yearbook*, Bureau of Mines, Department of the Interior. Fuel consumption in the generation of electric energy is published annually by the Federal Power Commission, in *Electric Power Statistics*. For a general discussion and analysis, see F. G. Tryon and H. O. Rogers, "Statistical Studies of Progress in Fuel Efficiency," *Transactions, Second World Power Conference*, Berlin, 1930, vol. VI.

TABLE 1.—*Energy consumption in manufacturing industries, 1909–39 (bituminous coal or equivalent)*

[Quantities in thousands of tons]

	1909		1914		1919		1929		1937		1939	
	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent
Anthracite [1]	14, 202	7. 4	13, 730	6. 7	13, 436	5. 2	9, 334	3. 1	6, 419	2. 3	4, 907	2. 0
Bituminous coal	151, 205	78. 2	154, 283	75. 8	188, 233	73. 4	196, 780	65. 5	162, 961	58. 4	137, 771	56. 0
Fuel oil, gasoline, and kerosene [2]	4, 895	2. 5	7, 413	3. 6	15, 284	6. 0	30, 190	10. 0	31, 168	11. 1	30, 607	12. 5
Natural gas [3]	5, 765	3. 0	6, 918	3. 4	8, 602	3. 3	27, 613	9. 2	40, 805	14. 6	36, 190	14. 7
Water power (plant owned) [4]	9, 497	4. 9	7, 949	3. 9	6, 237	2. 4	3, 118	1. 0	2, 922	1. 1	2, 910	1. 2
Purchased manufactured gas [5]	1, 038	. 5	1, 300	. 6	1, 518	. 6	2, 083	. 7	2, 207	. 8	2, 289	. 9
Purchased electric energy [6]	6, 843	3. 5	12, 159	6. 0	23, 248	9. 1	31, 586	10. 5	32, 836	11. 7	31, 303	12. 7
Total	193, 445	100. 0	203, 752	100. 0	256, 558	100. 0	300, 704	100. 0	279, 318	100. 0	245, 977	100. 0
Tons per wage earner	39. 2		40. 1		40. 6		39. 0		37. 2		37. 4	

SOURCE: Computed from data in the *Census of Manufactures*, except as otherwise noted.

[1] Converted at 1 short ton anthracite=0.9782 ton bituminous coal.

[2] Fuel oil converted at 1 barrel=0.2288 ton bituminous coal, gasoline and kerosene at 1 barrel=0.2162 ton bituminous coal.

[3] Converted at MCF natural gas=0.04104 ton bituminous coal. In 1929 and 1937, quantities of natural gas used in the manufacture of carbon black, as reported in the *Minerals Yearbook* of the Bureau of Mines, added to quantities reported in *Census of Manufactures* to make figures comparable with other years.

[4] Calculated on basis of horsepower of installed water wheels and hydro turbines converted into electric energy at use factor calculated by weighting major water, power-using industries in each year in accordance with their 1939 use factors. Use-factors were determined to be as follows, in kilowatt hours, per horsepower of installed water wheels and hydro turbines: 1909, 2,084 kilowatt hours; 1914, 2,176 kilowatt hours; 1919, 2,208 kilowatt hours; 1929, 2,366 kilowatt hours; 1937, 2,562 kilowatt hours; 1939, 2,611 kilowatt hours. Electric energy then converted into bituminous coal on same basis as purchased electric energy (see footnote 6).

[5] Calculated by multiplying gas utility companies sales to manufacturers by bituminous coal equivalent of fuels actually used per volume unit of gas manufactured in year concerned. Conversion equivalents were determined to be as follows, in tons bituminous coal per MCF manufactured gas: 1909, 0.0632 ton; 1914, 0.0586 ton; 1919, 0.0452 ton; 1929, 0.0472 ton; 1937, 0.0436 ton; 1939, 0.0435 ton. Sales based on Census of Manufactures until 1929, and on American Gas Association reports since 1929, corrected to eliminate industrial sales other than to manufacturers.

[6] Converted to bituminous coal equivalent on basis of actual consumption in each year of fuel per kilowatt-hour at fuel-electric generating stations. Conversion equivalents per 1,000 kilowatt hours stated in tons bituminous coal, are as follows: 1909, 2.5 tons; 1914, 2.0 tons; 1919, 1.6 ton; 1929, 0.845 ton; 1937, 0.715 ton; 1939, 0.695 ton.

TABLE 2.—*Cost of fuel* [1] *and purchased energy in manufacturing industries, 1899–1939*

[Millions of dollars]

Year	Value of product	Value added by manufacture	Cost of materials, etc.	Cost of fuel and purchased energy	Cost of fuel	Cost of purchased energy	Ratio of fuel and purchased energy to value of product	Ratio of fuel and purchased energy to value added by manufacture	Ratio of fuel and purchased energy to cost of materials, etc.	Ratio of purchased energy to fuel and purchased energy
							Percent	*Percent*	*Percent*	*Percent*
1899	11, 104	4, 662	6, 442	207	197	10	1. 87	4. 43	3. 21	4. 8
1904	14, 346	6, 039	8, 307	325	308	17	2. 27	5. 38	3. 92	5. 2
1909	20, 068	8, 192	11, 876	570	[2] 510	[2] 60	2. 85	6. 97	4. 81	10. 5
1914	23, 065	9, 241	13, 824	666	[2] 566	[2] 100	2. 89	7. 21	4. 82	15. 0
1919	60, 054	23, 770	36, 284	1, 646	[2] 1, 468	[2] 278	2. 74	6. 92	4. 53	16. 9
1921	41, 749	17, 303	24, 446	[3] 1, 348			[3] 3. 23	[3] 7. 78	[3] 5. 51	
1923	58, 288	24, 630	33, 658	[3] 1, 724			[3] 2. 96	[3] 6. 99	[3] 5. 12	
1925	60, 926	25, 732	35, 194	[3] 1, 853			[3] 3. 04	[3] 7. 19	[3] 5. 27	
1927	60, 472	26, 427	34, 045	1, 897	[2] 1, 460	[2] 437	3. 14	7. 17	5. 56	23. 1
1929	68, 178	30, 737	37, 441	1, 974	1, 498	476	2. 90	6. 42	5. 27	24. 1
1931	39, 830	18, 601	21, 229	[3] 1, 276			[3] 3. 20	[3] 6. 85	[3] 6. 00	
1933	30, 557	14, 007	16, 550	[3] 947			[3] 3. 10	[3] 6. 76	[3] 5. 72	
1935	44, 994	18, 553	26, 441	1, 089	708	381	2. 42	5. 87	4. 12	35. 0
1937	60, 713	25, 174	35, 539	1, 425	957	468	2. 34	5. 76	4. 01	32. 8
1939	56, 829	24, 711	32, 118	1, 316	851	465	2. 32	5. 32	4. 09	35. 3

SOURCE: *Census of Manufactures.*

[1] Excluding coal and natural gas used as raw materials in the coke, fuel briquet, and carbon black industries.

[2] Distribution between fuel and purchased energy estimated.

[3] Estimated.

efficiency improvement. If this is true, a continued rise in the application of energy to industry in the future will in all likelihood be accompanied by an absolute (although not proportional) increase in energy resource consumption.

A particularly striking feature of the period covered in table 1 is the shift in relative importance of the various energy sources, which is shown graphically in figure 62. Industrial consumption of anthracite has fallen steadily, as better markets have been found in domestic heating and combustion equipment developed for domestic utilization of the smaller sizes. Plant-owned water power is no longer a considerable fraction of the total, although the development of private hydroelectric sites by electroprocess industries has recently increased the share of this energy source. The most profound alteration over the 30 years is the precipitous decline in the proportion supplied by bituminous coal, and its replacement by natural gas, fuel oil, and purchased electric energy. This decline amounts to no less than 28 percent from the high level of 1909. Even if the portion of purchased energy probably generated from coal is added in, the proportion of total energy supplied by bituminous coal has fallen from 82.7 percent in 1909 to 62.3 percent in 1939, a drop of almost one-quarter in the 30-year period.[4]

[4] Calculated for 1909 by allocating to bituminous coal a share of the purchased electric energy proportioned to the ratio of steam engines and turbines to total prime movers in central generating stations (estimated by linear interpolation from data in the *Census of Electrical Industries*, 1907 and 1912). For 1939 the allocation is in proportion to ratio of coal-generated electric energy to total energy generated in central stations, as reported by the Federal Power Commission, *Electric Power Statistics, 1939.*

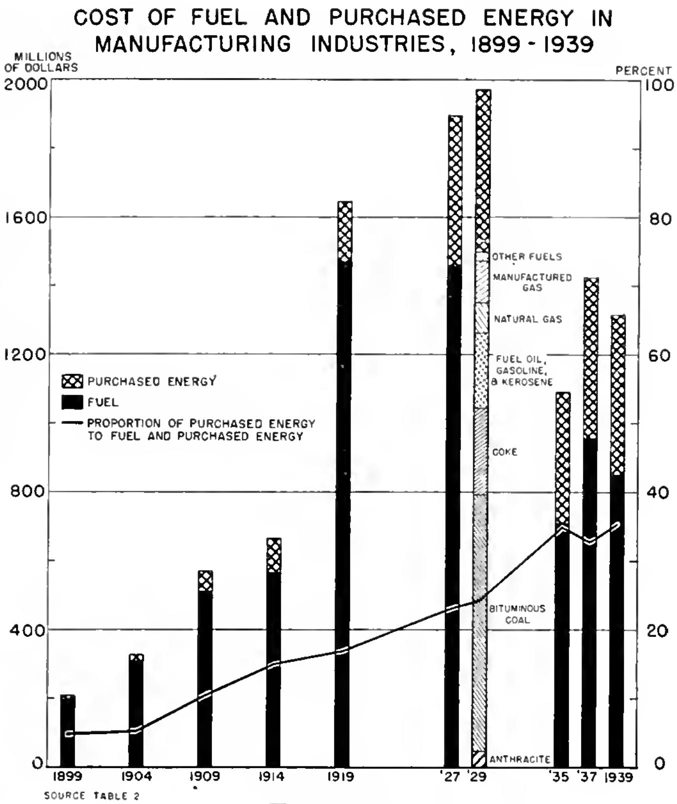

Figure 63

Although still outstripping its rival energy sources, coal no longer maintains the unquestioned leadership of earlier days. The relative rapidity with which our petroleum and natural-gas reserves are being depleted will necessarily cause an eventual reversal in these trends. It may be expected, however, that a steadily increasing fraction of coal-produced energy absorbed by manufactures will be consumed in the form of purchased electricity, and the direct locational significance of differential coal costs will be correspondingly diminished.

Costs

Reasonably comparable data on total costs of fuel and purchased energy in manufacturing industries are available for scattered years back to 1899; they are presented in table 2 and figure 63. The rapid rise in expenditures for purchased energy, both absolute and relative, is particularly noteworthy, and gives renewed emphasis to the increasing significance of power cost differentials.

As a general indication of the locational importance of fuel and power relative to other productive factors, the most useful single guide is the proportion of total costs absorbed by expenditures on energy. It is not, of course, to be supposed that this test affords a precise quantitative measure of locational significance. Its use is subject to all the qualifications discussed in chapter 13, below. For each energy source alone, intensity of physical consumption (stated in terms of physical units per dollar value of product) provides a more satisfactory measure, and it is employed in the later sections of this chapter. For any particular industry or plant, special considerations may give to any factor an attractive force out of all proportion to its relative cost. But for industry as a whole, cost offers the only reasonably close approximation of comparative locational attraction.

The ratios tabulated in table 2, and charted in figure 64, show the trends in energy costs relative to total costs over the last 40 years. A rising trend to 1921 has been succeeded by a gradual decline. Three elements have doubtless contributed to this decline: improved economy in fuel consumption, the declining trend in bituminous coal prices relative to other prices, and the shift from fuels to purchased electric energy, which has become markedly cheaper during the period here considered. Since the first and third of these elements are already slowing down, while the second has been reversed by statutory protection for coal prices, the future may well witness a gradual rise in the relative weight of energy costs.

Even a substantial increase, however, will still leave these costs comparatively small. In recent years, in manufacturing industries, expenditures on fuel and power have amounted to less than 2½ percent of the total value of product, and it must be recalled that this latter figure excludes the costs of transportation to the market and of distribution. In the great majority of industries, fuel and power are locationally insignificant in comparison with markets, raw materials, and labor.

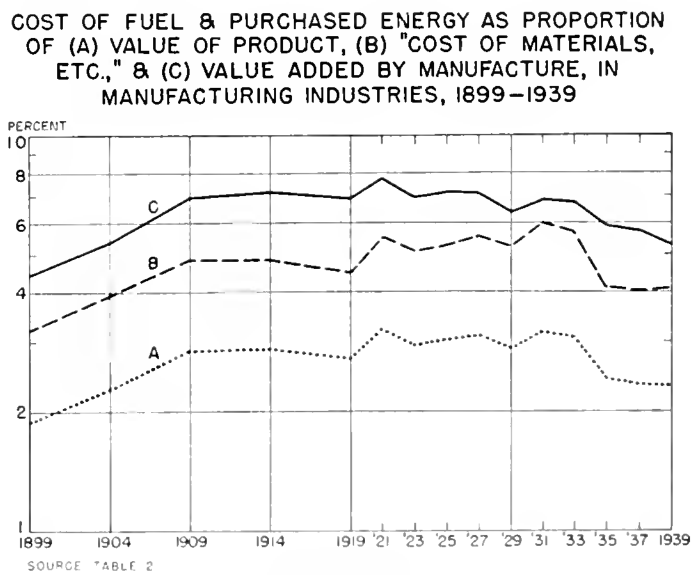

Figure 64

TABLE 3.—*Cost of fuel and purchased energy in manufacturing industries, 1939, by industry groups*

[Values in millions of dollars]

	Value of product	Fuel and purchased energy		Fuel		Purchased energy	
		Cost	Ratio to value of product	Cost	Ratio to value of product	Cost	Ratio to value of product
			Percent		*Percent*		*Percent*
All industries	56,828.8	1,315.9	2.32	850.5	1.50	465.4	0.82
Stone, clay, and glass products	1,440.2	116.3	8.08	84.3	5.85	32.0	2.22
Iron and steel and their products, except machinery	6,591.5	390.3	5.92	316.2	4.80	74.1	1.12
Paper and allied products	2,019.6	84.5	4.18	58.7	2.91	25.8	1.28
Products of petroleum and coal	2,954.0	83.9	2.84	69.5	2.35	14.4	.49
Chemicals and allied products	3,733.7	98.5	2.64	62.7	1.68	35.8	.96
Textile-mill products and other fiber manufactures	3,897.4	96.1	2.47	42.3	1.09	53.8	1.38
Nonferrous metals and their products	2,572.9	52.9	2.06	27.8	1.08	25.1	.98
Rubber products	902.3	17.9	1.98	7.7	.85	10.2	1.13
Food and kindred products	10,604.0	161.9	1.53	87.0	.82	74.9	.71
Machinery (except electrical)	3,254.2	47.7	1.47	22.8	.70	24.9	.77
Furniture and finished lumber products	1,267.7	16.7	1.32	7.7	.61	9.0	.71
Lumber and timber basic products	1,122.1	14.1	1.26	7.1	.63	7.0	.62
Electrical machinery	1,727.2	21.5	1.24	9.6	.56	11.9	.69
Miscellaneous industries	1,163.0	13.9	1.20	6.1	.52	7.8	.67
Transportation equipment except automobiles	882.9	10.1	1.14	4.8	.54	5.3	.60
Printing, publishing, and allied industries	2,578.5	24.9	.97	6.7	.26	18.2	.71
Automobiles and automobile equipment	4,047.9	35.5	.88	18.8	.46	16.7	.41
Leather and leather products	1,389.5	11.6	.83	5.9	.42	5.7	.41
Apparel and other finished products made from fabrics and similar material	3,358.3	15.4	.46	3.4	.10	12.0	.36
Tobacco manufactures	1,322.2	2.2	.17	1.2	.09	1.0	.08

SOURCE: *Census of Manufactures*, 1939.

On the other hand, certain compensatory considerations give to the energy resources more locational importance than appears at first glance. The geographical variation in costs is unusually large; as shown below, it ranges from 3 cents to 28 cents per million Btu for heavy consumers of fuel, and from 4 mills to 26 mills per kilowatt-hour for industrial power consumers with comparable demand and load factors. It is evident that a shift from high-cost to low-cost areas offers the possibility of large savings. The total invested capital in manufacturing industries in 1929 has been estimated at $50 billions.[5] A 25 percent reduction in over-all fuel and power costs in that year would have amounted to $493,500,000, the equivalent of almost 1 percent additional return on capital. In the early years of mechanization, moreover, transportation of water power was impossible and that of coal extremely expensive, so that these factors exercised a locational influence far beyond their importance in total costs. Finally, and perhaps most important, a number of the heavy power and fuel consumers, for which these costs amount to a large fraction of the total, are major basic industries which tend to attract about them clusterings of secondary industrial activity.

When the cost data are broken down by industries, there is at once apparent a wide diversity in the importance of energy expenditures. In table 3, the data are shown for the industry groups employed in the 1939 *Census of Manufactures*, ranked in descending order of proportion of fuel and purchased energy costs to total value of product. This tabulation indicates clearly the tendency of the more intensive energy consumers to be found among the primary industries. The same tendency is even more sharply demonstrated in table 4, which shows the leading individual industries ranked in the same order. The value of product of the 27 industries with energy costs amounting to 5 percent or more of the total was $8,580,459,000, or over 14 percent of the value of product of all manufacturing industries. It is in this group that energy orientation is most likely to be found.

To complete the over-all picture, table 5 shows the physical consumption of the leading energy sources in 1939, by industry groups.[6] The significance of these data in terms of orientation toward particular fuels or electric energy will be analyzed in the following sections of this chapter.

Orientation Toward Fuel Resources

The earliest significant effect of energy resources on the location of American manufacturing industries was undoubtedly exercised by water power. In the first period of industrial growth, wood, which supplied almost all fuel needs, was virtually ubiquitous. Falling

[5] C. A. Bliss, *The Structure of Manufacturing Production*, National Bureau of Economic Research, New York, 1939, p. 11.

[6] In that year, for the first time, the *Census of Manufactures* reported data for electric energy generated in manufacturing plants as well as purchased electricity. The figures for electricity have been computed by adding together the quantities generated and purchased, and subtracting the quantity sold. There is consequently considerable duplication between electricity and the fuels, since most plant-generated electricity is produced by the combustion of one or another of the fuels. Data for coke and manufactured gas have not been tabulated, since over 91 percent of the former and over 79 percent of the latter were consumed by the iron and steel industry alone. The only other large consumers of manufactured gas were petroleum refining (12.5 percent) and coke (3.1 percent). The only large industrial consumer of anthracite was the primary smelting and refining of zinc in New Jersey and eastern Pennsylvania.

TABLE 4.—*Cost of fuel and purchased energy in selected manufacturing industries, 1937* [1]

[Values in thousands of dollars]

Industry	Value of product	Fuel and purchased energy		Fuel		Purchased energy	
		Cost	Ratio to value of product	Cost	Ratio to value of product	Cost	Ratio to value of product
			Percent		*Percent*		*Percent*
1. Coke oven products [2]	397, 925	272, 202	68. 41	270, 359	67. 95	1, 843	0. 46
2. Blast furnace products	672, 525	177, 492	26. 39	175, 971	26. 16	1, 521	. 23
3. Bone black, carbon black, and lampblack [3]	18, 854	4, 602	24. 41	4, 572	24. 25	30	. 16
4. Cement	183, 201	34, 317	18. 73	24, 936	13. 61	9, 381	5. 12
5. Lime	35, 022	6, 055	17. 29	4, 745	13. 55	1, 310	3. 74
6. Ice, manufactured	136, 542	21, 316	15. 62	4, 192	3. 07	17, 124	12. 55
7. Clay products, other than pottery	163, 262	24, 854	15. 23	20, 696	12. 68	4, 158	2. 55
8. Nonclay refractories	28, 457	2, 796	9. 83	2, 302	8. 09	494	1. 74
9. Salt	32, 741	2, 552	7. 80	2, 298	7. 02	254	. 78
10. Pulp (wood and other fiber)	247, 192	19, 189	7. 77	13, 263	5 37	5, 926	2. 40
11. Smelting and refining, zinc	115, 655	8, 708	7. 53	6, 082	5. 26	2, 626	2. 27
12. Sand-lime brick	1, 618	122	7. 54	74	4. 57	48	2. 97
13. Wallboard and plaster (except gypsum)	41, 049	2, 966	7. 22	1, 830	4. 46	1, 136	2. 76
14. Glass	387, 710	26, 742	6. 90	21, 138	5. 45	5, 604	1. 45
15. Minerals and earths, ground or otherwise treated	27, 161	1, 828	6. 73	824	3. 03	1, 004	3. 70
16. Chemicals, not elsewhere classified	932, 750	62, 599	6. 71	35, 443	3. 80	27, 156	2. 91
17. Dyeing and finishing, rayon and silk fabrics	57, 599	3, 808	6. 61	3, 247	5. 64	561	. 97
18. Woolen and worsted, dyeing and finishing	11, 603	731	6. 61	608	5. 51	122	1. 10
19. Paper	957, 940	58, 991	6. 15	43, 461	4. 53	15, 530	1. 62
20. Foundry products	397, 303	24, 297	6. 12	17, 737	4. 47	6, 560	1. 65
21. Compressed and liquefied gases	56, 418	3, 412	6. 05	358	. 63	3, 054	5. 42
22. Steel-works and rolling mill products	3, 330, 491	191, 130	5. 74	149, 450	4. 49	41, 680	1. 25
23. Gypsum products	42, 617	2, 379	5. 58	1, 309	3. 07	1, 070	2. 51
24. Cast-iron pipe and fittings	61, 118	3, 195	5. 22	2, 419	3. 95	776	1. 27
25. Iron and steel forgings	122, 835	6, 301	5. 13	4, 773	3. 89	1, 528	1. 24
26. Pottery, including porcelain ware	94, 726	4, 800	5. 07	3, 823	4. 04	977	1. 03
27. Wood distillation and charcoal manufacture	26, 145	1, 308	5. 00	1, 094	4. 18	214	. 82
28. Glue and gelatin	40, 650	1, 909	4. 69	1, 739	4. 27	170	. 42
29. Wool scouring	4, 550	210	4. 62	155	3. 41	55	1. 21
30. Electroplating	26, 686	1, 200	4. 49	326	1. 22	874	3. 27
31. Sugar, beet	107, 360	4, 843	4. 51	4, 666	4 35	177	. 16
32. Dyeing and finishing, cotton-fabric	204, 052	8, 834	4. 33	7, 323	3. 59	1. 511	. 74
33. Fuel briquets	6, 137	238	3. 88	71	1. 16	167	2. 72
34. Grease and tallow	52, 269	1, 968	3. 76	1, 360	2. 60	608	1. 16
35. Paving materials—blocks (except brick and stone and mixtures)	25, 289	949	3. 75	718	2. 84	231	. 91
36. Marble, granite, slate, and other stone, cut and shaped	79, 006	2, 945	3. 73	618	. 78	2, 327	2. 95
37. Galvanizing and other coating	5, 994	219	3. 65	156	2. 60	63	1. 05
38. Petroleum refining	2, 546, 746	93, 136	3. 65	83, 665	3. 28	9, 471	. 37
39. Coke-oven products	357, 469	12, 986	3. 63	11, 143	3. 12	1, 843	. 51
40. Sugar, cane, not including products of refineries	29, 151	1, 057	3. 62	1, 006	3. 45	51	. 17
41. Cotton yarn and thread	260, 604	9, 354	3. 59	1, 551	. 60	7, 803	2. 99
42. Cotton, broad-woven goods	967, 110	32, 377	3. 35	8, 263	. 85	24, 114	2. 50
43. Springs, steel	27, 233	893	3. 28	610	2. 24	283	1. 04
44. Plumbers' supplies	113, 920	3, 617	3. 17	2, 293	2. 01	1, 324	1. 16
45. Files	13, 653	422	3. 09	259	1. 90	163	1. 19
46. Asbestos products	63, 794	1, 936	3. 04	1, 179	1. 85	757	1. 19
47. Rubber goods, miscellaneous	242, 717	7, 316	3. 01	2, 979	1. 23	4, 337	1. 78

SOURCE: Computed from data in *Census of Manufactures, 1937.*

[1] Includes all industries with expenditure for fuel and purchased energy exceeding 3 percent of the value of product, except industries operating exclusively on contract or commission.

[2] "Cost of fuel" includes cost of coal used as a material. Data from *Minerals Yearbook, 1939.*

[3] "Cost of fuel" includes cost of natural gas used as a material in the carbon black industry. Data on carbon black from *Minerals Yearbook, 1939.*

TABLE 5.—*Consumption of fuels and electric energy in manufacturing industries, 1939, by industry groups*

	Value of product ($000,000)	Bituminous coal		Fuel oil		Natural gas		Electric energy	
		Consumption (thousands of tons)	Tons per $1,000 value of product	Consumption (thousands of barrels)	Barrels per $1,000 value of product	Consumption (millions of cubic feet)	Cubic feet per dollar value of product	Consumption [1] (millions of kilowatt-hours)	Kilowatt-hours per dollar value of product
All industries	56, 828. 8	137, 771	2. 42	133, 774	2. 35	881, 830	15. 51	70, 868	1. 25
Food and kindred products	10, 604. 0	10, 570	1. 00	11, 325	1. 07	79, 133	7. 46	6, 388	. 60
Tobacco manufactures	1, 322. 2	243	. 18	36	. 03	16	. 01	115	. 09
Textile mill products and other fiber manufactures	3, 897. 4	5, 520	1. 42	9, 252	2. 37	2, 719	. 70	6, 800	1. 75
Apparel and other finished products made from fabrics and similar materials	3, 358. 3	314	. 09	437	. 13	1, 383	. 40	356	. 11
Lumber and timber basic products	1, 122. 1	385	. 38	714	. 63	232	. 21	1, 238	1. 10
Furniture and finished lumber products	1, 267. 7	1, 407	1. 11	508	. 40	2, 201	1. 74	603	. 48
Paper and allied products	2, 019. 6	9, 195	4. 57	6, 696	3. 32	29, 518	14. 62	9, 394	4. 66
Printing, publishing and allied industries	2, 578. 5	413	. 16	603	. 23	2, 189	. 85	859	. 31
Chemicals and allied products	3, 733. 7	9, 659	2. 59	11, 493	3. 08	304, 958	81. 68	9, 811	2. 63
Products of petroleum and coal	2, 954. 0	63, 767	21. 60	38, 261	12. 94	118, 574	40. 14	3, 440	1. 16
Rubber products	902. 3	1, 848	2. 02	671	. 74	3, 372	4. 14	1, 584	1. 76
Leather and leather products	1, 389. 5	999	. 72	394	. 28	859	. 62	402	. 29
Stone, clay, and glass products	1, 440. 2	12, 223	8. 49	8, 113	5. 63	148, 075	102. 82	4, 852	3. 37
Iron and steel and their products, except machinery	6, 591. 5	12, 262	1. 86	33, 055	5. 02	122, 466	18. 58	12, 238	1. 86
Nonferrous metals and their products	2, 572. 9	1, 789	. 70	4, 550	1. 77	36, 583	14. 22	5, 956	2. 32
Electrical machinery	1, 727. 2	1, 182	. 71	1, 284	. 74	3, 350	1. 94	1, 432	. 83
Machinery (except electrical)	3, 254. 2	2, 443	. 75	2, 993	. 91	9, 944	3. 06	1, 985	. 61
Automobiles and automobile equipment	4, 047. 9	2, 561	. 63	1, 621	. 40	9, 514	2. 33	2, 467	. 61
Transportation equipment, except automobiles	882. 9	497	. 56	1, 059	1. 20	1, 071	1. 21	482	. 55
Miscellaneous industries	1, 163. 0	494	. 42	711	. 61	5, 412	4. 66	466	. 40

SOURCE: Computed from data in *Census of Manufactures, 1939.*

[1] Energy generated in plant plus energy purchased less energy sold.

water, which was the sole source of mechanical energy in quantities larger than could be supplied by man or beast, was necessarily utilized directly at the site. The geographical structure of New England industry, notably in textiles, shoes, and paper products, still reflects this early influence, although direct waterpower drive of machinery has become relatively unimportant.[7]

It was in the second phase of American industrialization, when iron and steel came to the fore as the Nation's leading industry, that the broad outlines of the modern locational pattern were laid out. In this process, the position of the great Appalachian coal fields played a leading part. It is no exaggeration, indeed, to attribute to the conjunction of these coal deposits with the iron ore on the Great Lakes waterway system a more profound locational significance than to any other single factor. The great basic iron and steel industry served as a pole of attraction for processing industries and stimulated in turn the growth of population and the development of transportation and other services, establishing the country's major industrial belt. A similar phenomenon on a much smaller scale has been witnessed in the area around Birmingham, Ala.

More recently, as has been shown above, coal has tended to decline in importance relative to the petroleum fuels and to purchased electric energy (much of which is generated from water power or fuels other than coal). The influence of this shift in fuels on the total geographical structure of industry is as yet relatively small, since alterations in the pattern necessarily occur but slowly. "Oil and gas," writes one authority, "have attracted to themselves comparatively little manufacturing activity."[8] This is particularly true of oil, which in most areas, at the relative prices obtaining over the past two decades, is a considerably more expensive fuel than either coal or natural gas. Natural gas, on the other hand, whether available at the fields or by pipe line, is substantially cheaper than coal except at the mine mouth, and, in terms of convenience and heat control, is clearly an ideal fuel.

[7] In 1939, the Census Bureau reported 1,603,669 horsepower of hydro-turbines and water wheels in manufacturing plants, of which 1,208,624 horsepower, or 75 percent, were used to drive electric generators. Of the remaining 395,045 horsepower, over 280,000 horsepower were employed in the paper and pulp industries, largely in Maine.

[8] National Resources Committee, *Energy Resources and National Policy*, 1939, p. 124.

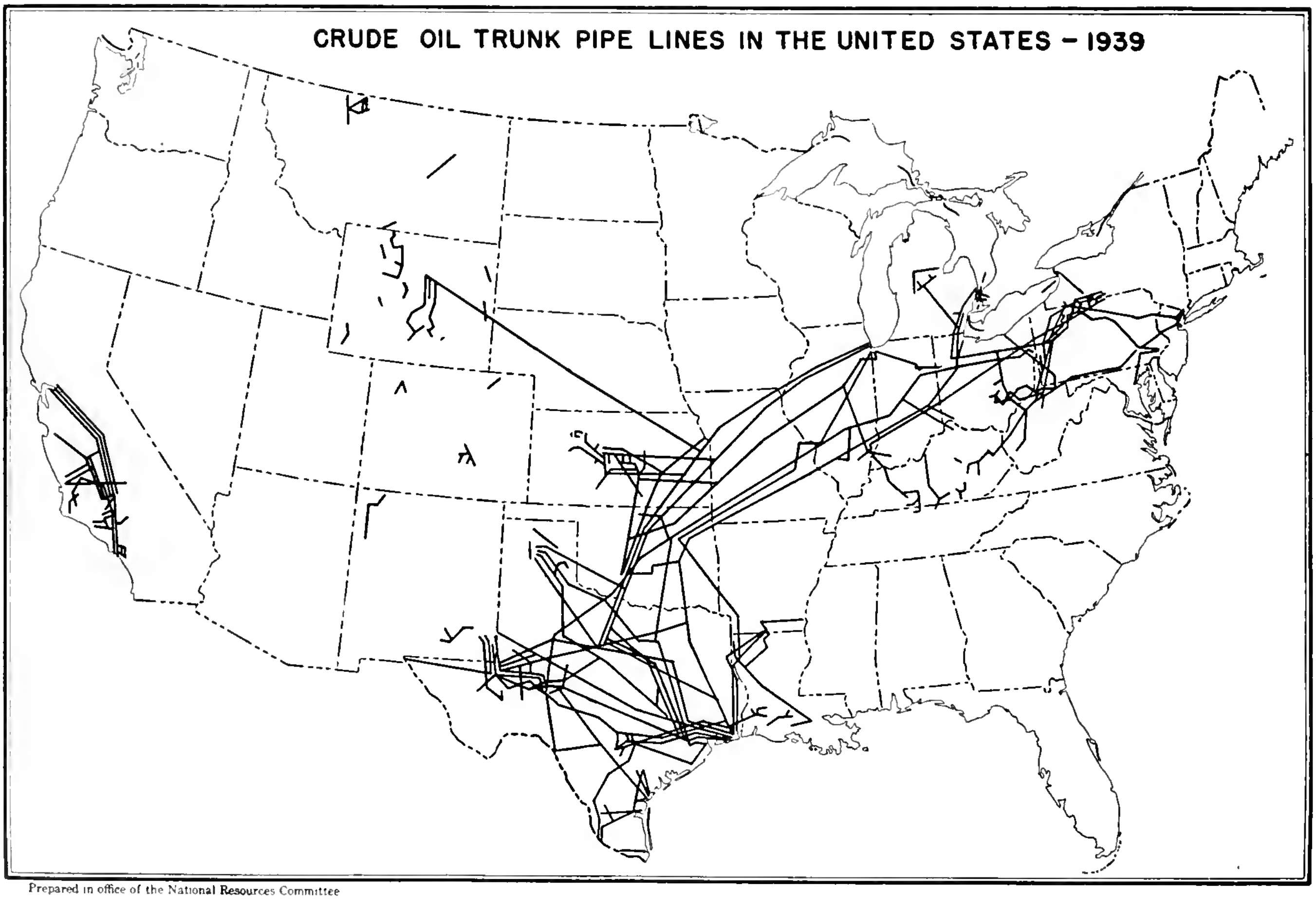

FIGURE 65

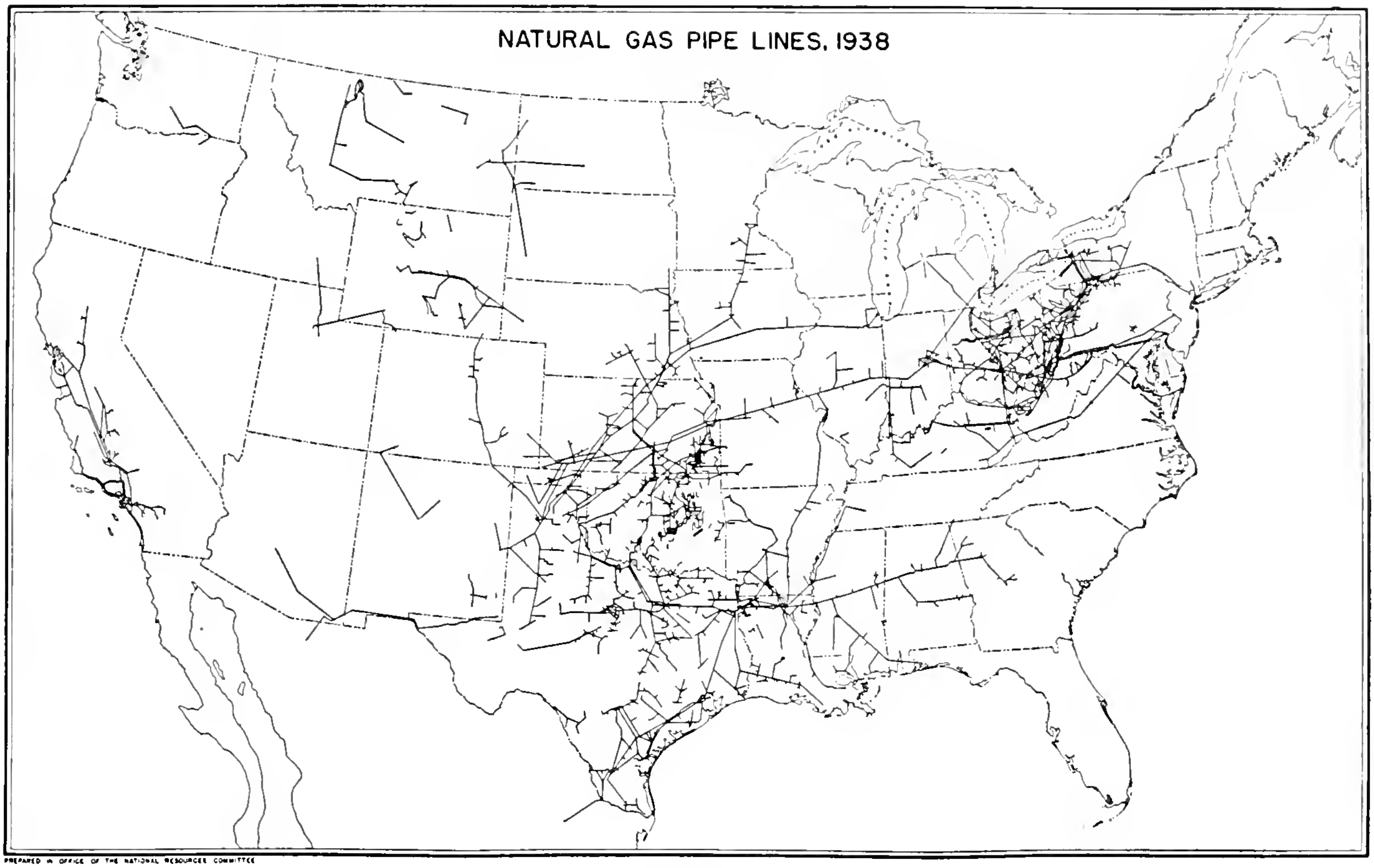

FIGURE 66

In the last two decades of the nineteenth century, gas field discoveries in Pennsylvania, Ohio, and Indiana led to a substantial industrial movement to those areas, stimulated by extremely low prices and local claims of "inexhaustibility." In the middle eighties, natural gas was furnished free in sections of Indiana, local communities bearing the costs of drilling in order to foster industrial development. The glass industry was particularly prominent in this movement, along with woodworking, small iron and steel manufactures, and brick and tile.[9] Such cities as Marion, Muncie, Anderson, and Kokomo owe their industrial development largely to cheap or free natural gas during this era. Toward the end of the century, as reserves neared exhaustion, some plants moved elsewhere, while others shifted to coal or to manufactured or mixed gas. Smaller communities were often left stranded, but in most cases a large section of the industrial development remained permanently. During the early years of the twentieth century, similar short-lived "gas booms" occurred in some portions of Kansas and Oklahoma.

[9] For a record of the rise and decline of industrial use of Indiana natural gas, see Indiana Department of Geology and Natural History, *Annual Report*, 1886–1908.

In recent years, industrial development based on natural gas has focussed in areas in which reserves appear adequate for several decades to come. Not only the carbon-black industry, for which natural gas is the raw material, and the glass industry, in which gas (either natural or manufactured) must be used for technological reasons, but a number of other heavy fuel-consuming industries are displaying a perceptible tendency to develop new units in the low-cost natural gas region of the Southwest. And as electrification proceeds apace, and the electroprocess industries gain in importance in the economy as a whole, low-cost water power in the Pacific States and the Southern Appalachians is rapidly gaining in significance as an attractive force to industry. Thus current trends suggest a reduction in the marked coal orientation of the past and, in so far as energy orientation is a significant factor, a dispersion of new plants away from the traditional industrial belt.

Large geographical variations in fuel prices are a consequence of the limited area of the higher-grade natural deposits and high transportation costs. For coal, despite extremely low ton-mile rail freight rates and even lower costs for water haulage, transportation

amounts on the average to about half the delivered price. Crude oil tanker transportation is normally very cheap, but pipe-line costs are estimated to be more than twice as high and railroad tank car rates at least six times as high. The natural gas pipe line network is limited in extent, and a large volume of surplus gas in the major producing areas is consequently available for industrial uses at very low cost. Oil and gas pipe lines are shown in figures 65 and 66.

The resultant pattern is indicated by figure 67. This map shows on a comparable basis the cost in 1938 of various fuels used at selected power plants for raising steam, the different fuels being indicated by separate symbols. The location of the major coal, oil, and natural gas producing areas is also shown. Although these cost figures are affected in some measure by such factors as the size of power plant, the negotiation of long-term fuel contracts under particularly favorable or adverse conditions, and the suitability of stoking and combustion equipment for burning the lower-cost sizes and grades of coal, they provide on the whole a reasonably satisfactory portrait of the geographical structure of fuel costs.

It will be noted that, in the case of coal, costs are at their lowest at the mines, and increase rapidly with increasing distance from the coal fields by rail, but less rapidly at points served by water transportation. In general, costs of 10 cents or less per million Btu are found only at the mine mouth, points from 11 cents through 18 cents occur either close to the mines or on developed waterways (inland or coastal), while points above 18 cents are at considerable distance from the coal fields and accessible only by rail. The highest coal costs indicated on the map are in inland Massachusetts, Minnesota, western Wisconsin, and eastern South Dakota. The unusual importance of transportation in delivered coal costs is strikingly demonstrated by the range, which varies from 4 cents per million Btu in one portion of the southern Appalachian coal fields to a high of 28 cents in the areas mentioned above.

The data for fuel oil are far less numerous than those for coal, and show a smaller price spread. Except for California, the major industrial fuel oil consuming regions are not the oil producing States themselves, where cheaper natural gas is employed by preference, but seaboard States accessible to tanker transportation. The only steam-electric plant reporting costs, where fuel oil is used as the sole fuel in an oil-producing region, is Port Arthur, Texas, with a cost of 13 cents per million Btu.[10] Many plants in the oil regions burn both oil and gas, and in California, particularly, a large share of the fuel is doubtless oil. Data are unfortunately lacking to indicate the proportions used and their respective costs. For the oil plants alone, delivered costs around the Gulf and Atlantic coasts range from 16 to 22 cents per million Btu, generally increasing with the length of tanker haul. The rather small differential suggests a correspondingly slight degree of orientation of fuel consumers toward the oil-producing regions as such—a conclusion which is strongly supported by other evidence as well.

By contrast with oil, natural gas is very heavily consumed in the immediate producing areas, and shows a very marked cost increase at distant points. In the Southwestern fields where this resource is most abundant relative to the market, and where billions of cubic feet are annually blown into the air, natural gas is obtainable for industrial purposes at 3 to 6 cents per million Btu. Noteworthy among these points are the Texas Panhandle, northern Oklahoma, and Jackson, Miss.[11] At other gas-consuming points, costs run as high as 16 to 21 cents per million Btu, while in some of the gas fields this fuel is not used for industrial purposes.

The somewhat peculiar pattern of gas costs is a result of the location of pipe lines and of enormous geographical differences in marketability. The average value of gas at the point of consumption in 1938 was 16.1 cents per million Btu for general industrial use, compared with 74.2 cents for domestic use, 47.1 cents for commercial use, 4.3 cents for consumption in the oil and gas fields, and 0.9 cent for use in the carbon black industry.[12] While industrial sales are more lucrative than the "dump" consumption in the field or in making carbon black, they rank far behind domestic and commercial use in attractiveness as markets. The Appalachian production, therefore, goes mostly into these uses. Only in the Southwest are reserves so great that large-scale industrial consumption can be expected for a substantial period in the future. As additional pipe lines are brought out from this area, the scope of industrial consumption can be broadened to some extent. Beyond a distance of a few hundred miles, however, pipe-line construction appears uneconomical unless a large share of the transported gas can be sold for domestic and commercial consumption.

How far do these striking geographical cost differences produce industrial orientation toward the lower-cost areas? An approximate measure of this tendency for industry as a whole is suggested by table 6, which

[10] A large number of small plants, both within and outside of the oil regions, reported cost figures for oil used in internal-combustion engines. The cost per Btu of Diesel oil or gasoline, however, is far higher than for fuel oil, and the figures are not comparable with those shown on the map.

[11] In the years since 1938, the Jackson field has fallen off sharply in production, and shows signs of approaching exhaustion.

[12] Computed from data in *Minerals Yearbook*, 1940, pp. 1068–1071, on basis of 1,045 Btu per cubic ft.

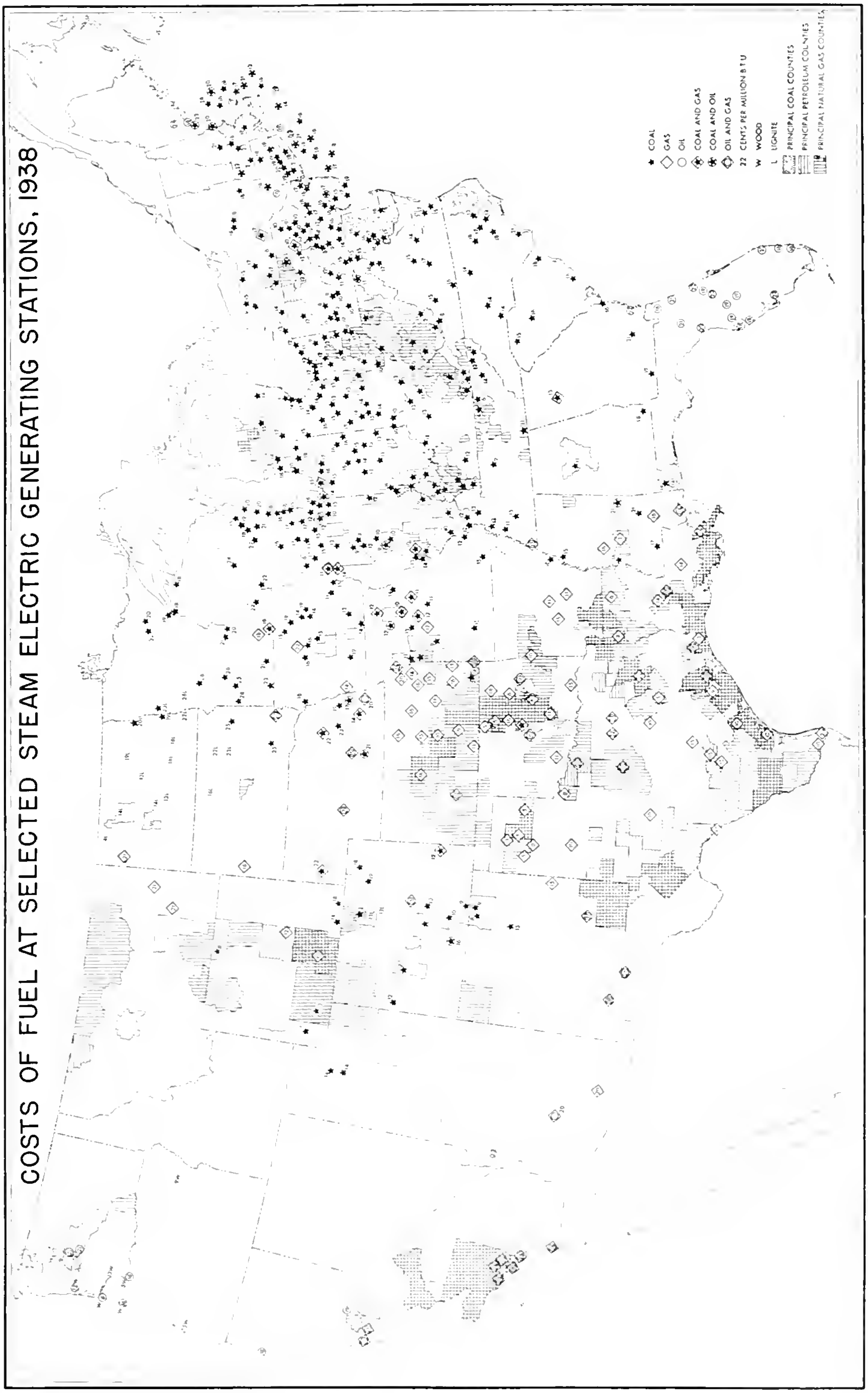
COSTS OF FUEL AT SELECTED STEAM ELECTRIC GENERATING STATIONS, 1938
COAL
GAS
OIL
COAL AND GAS
COAL AND OIL
OIL AND GAS
22 CENTS PER MILLION B.T.U.
W WOOD
L LIGNITE
PRINCIPAL COAL COUNTIES
PRINCIPAL PETROLEUM COUNTIES
PRINCIPAL NATURAL GAS COUNTIES

FIGURE 67

TABLE 6.—*Consumption of fuels in manufacturing industries, 1939*

	Consumption of fuels	Cost per million B. t. u.	Consumption per wage earner
	Billions B. t. u.	*Cents*	*Millions B. t. u.*
UNITED STATES	5,367,386	15.8	681
GEOGRAPHIC DIVISIONS			
1. West South Central	510,948	6.6	1,946
2. East South Central	309,013	12.1	864
3. Mountain	123,612	14.9	1,785
4. Middle Atlantic	1,565,601	16.1	696
5. South Atlantic	452,176	16.3	458
6. West North Central	218,370	16.8	571
7. East North Central	1,715,751	17.7	781
8. Pacific	186,368	18.4	413
9. New England	285,518	20.8	299
STATES			
1. Texas	336,974	5.1	2,654
2. Louisiana	104,949	9.1	1,474
3. Oklahoma	53,086	9.2	1,888
4. Utah	28,858	10.5	2,498
5. West Virginia	152,178	11.2	2,029
6. Alabama	182,439	11.2	1,562
7. Kentucky	54,687	12.5	871
8. Arkansas	15,915	12.7	439
9. Wyoming	9,855	13.1	2,829
10. Tennessee	59,843	13.6	454
11. Colorado	49,290	13.6	2,078
12. Kansas	41,343	13.7	1,308
13. Pennsylvania	948,758	15.0	1,105
14. California	154,284	15.0	519
15. Missouri	68,980	15.1	386
16. Virginia	67,052	16.5	501
17. Rhode Island	32,725	16.7	308
18. Indiana	342,694	17.0	1,235
19. Iowa	40,037	17.0	613
20. Mississippi	12,050	17.0	260
21. Michigan	316,208	17.1	605
22. Montana	14,014	17.2	1,528
23. New York	392,241	17.5	409
24. Ohio	610,157	17.6	1,020
25. New Mexico	3,320	18.0	1,022
26. Maryland	111,557	18.4	788
27. Illinois	341,305	18.4	577
28. North Dakota	2,118	18.4	803
29. New Jersey	224,578	18.5	518
30. Georgia	28,290	19.4	179
31. South Carolina	29,469	19.4	232
32. Massachusetts	139,856	19.9	304
33. Minnesota	52,637	20.0	660
34. South Dakota	3,071	20.2	555
35. Wisconsin	102,414	20.4	510
36. Connecticut	66,404	20.9	284
37. Florida	13,393	21.2	254
38. Delaware	12,147	21.3	596
39. North Carolina	36,270	21.4	134
40. Nebraska	10,203	22.0	542
41. Arizona	9,945	22.6	1,631
42. Nevada	3,247	23.1	2,971
43. Maine	28,312	24.8	374
44. Idaho	5,082	26.2	467
45. New Hampshire	13,700	27.6	246
46. District of Columbia	1,846	29.4	234
47. Washington	24,456	32.4	271
48. Vermont	4,493	33.0	206
49. Oregon	7,626	43.6	120

SOURCE: *Census of Manufactures.*

COST OF FUEL & CONSUMPTION PER WAGE EARNER, 1939, BY GEOGRAPHIC DIVISIONS AND STATES

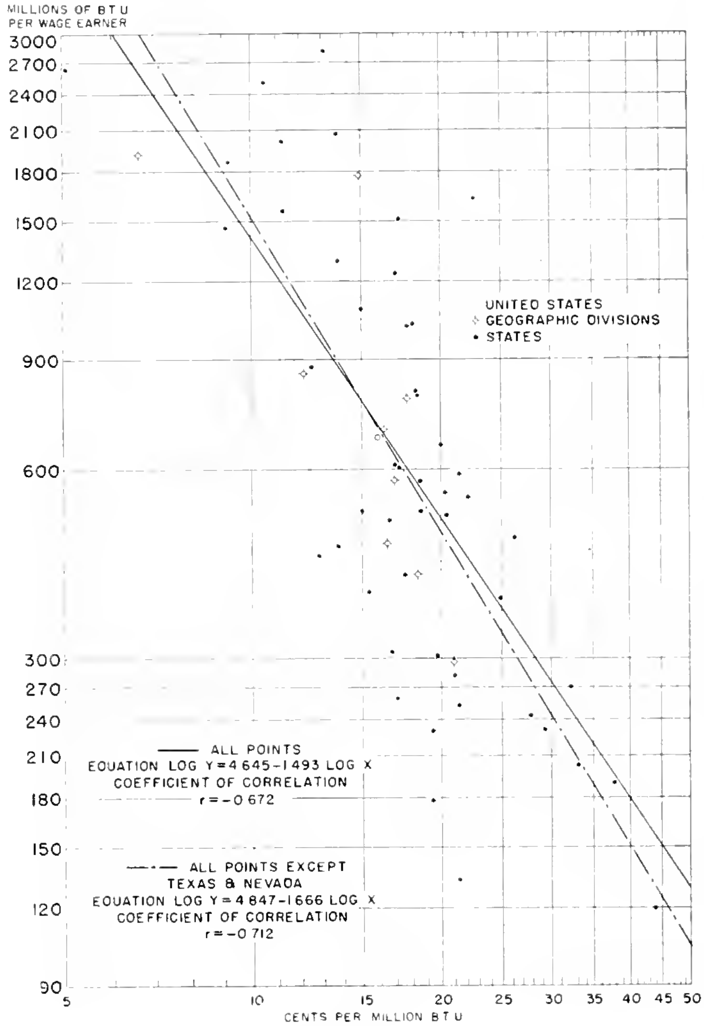

FIGURE 68

presents the total fuel consumption in equivalent heat units, the unit cost, and the consumption per wage earner, by geographic divisions and States, arrayed in order of ascending unit cost. In figure 68 unit cost and consumption per wage earner are plotted against one another, on a double logarithmic scale, with lines of regression (a) for all the points, and (b) all points except Texas and Nevada.[13] The data show a significant inverse correlation between cost and intensity of consumption, the coefficient of correlation for the second line of regression (excluding Texas and Nevada) being −.712. The slope of this line, which is 1.67, is an indication of the elasticity of demand for fuels for all industries taken as a whole. Since in any given industry, however, the elasticity of demand for fuels is likely to be quite small, fuel generally being required for technological reasons in approximately fixed proportions to other factors, this correlation is in fact occasioned by the concentration of more intensive fuel consuming industries in the lower-cost area. While the correlation is far from perfect, and the use of States as units conceals a wide variation in costs within each State, the analysis none the less suggests a very far-reaching degree of general fuel orientation.

Orientation of particular industries toward particular fuels is more difficult to measure, in part because of lack of data and in part because of the admixture of

[13] Elimination of these two points avoids considerable distortion, since the Texas data are thrown out of line by an enormous consumption of natural gas at "dump" prices in carbon black manufacture, while Nevada has too small a number of wage earners to be comparable with other States.

Table 7.—*Consumption of bituminous coal in selected manufacturing industries, 1939*

Industry	Value of product	Tons of bituminous coal consumed	Tons per $1,000 value of product
All industries	$56,828,807,223	137,771,432	2.4
1. Beehive coke	4,781,094	1,349,503	282.3
2. Oven coke and coke-oven byproducts	342,197,303	61,463,640	179.6
3. Sewer pipe and kindred products	18,295,679	715,239	39.1
4. Clay products (except pottery) not elsewhere classified	4,450,202	124,270	27.9
5. Brick and hollow structural tile	78,153,227	2,134,720	27.3
6. Cement	192,611,304	5,196,964	27.0
7. Lime	36,971,171	800,846	21.7
8. Hardwood distillation and charcoal manufacturing	6,843,172	134,703	19.7
9. Clay refractories, including refractory cement (clay)	42,191,454	813,447	19.3
10. Nonclay refractories	26,906,439	482,415	17.9
11. Salt	27,530,172	493,084	17.9
12. Liquors, distilled	56,080,195	537,695	9.6
13. Corn sirup, corn sugar, corn oil, and starch	119,408,253	1,081,630	9.1
14. Pulp mills; paper and paperboard mills	1,159,867,486	8,723,849	7.5
15. Terra cotta	3,175,310	23,496	7.4
16. Malleable-iron castings	53,450,770	384,083	7.2
17. Mineral wool	8,237,553	56,125	6.8
18. Rayon and allied products	247,065,556	1,647,215	6.7
19. Sand-lime brick, block, and tile	1,915,878	12,865	6.7
20. Reclaimed rubber	6,894,018	42,314	6.1
21. Chemicals not elsewhere classified	839,750,366	4,743,352	5.6
22. Glue and gelatio	34 331,639	191,219	5.6
23. Roofing tile	1,824,881	9,883	5.4
24. Grease and tallow (except lubricating greases)	58,226,218	258,902	4.4
25. Coal-tar products, crude and intermediate	42,917,034	180,964	4.2
26. Woolen and worsted manufactures—contract factories	13,156,533	55,318	4.2
27. Fuel briquets	5,287,282	20,970	4.0
28. Baking powder, yeast, and other leavening compounds	31,774,637	122,122	3.8
29. Processed waste and recovered wool fibers—contract factories	1,449,449	5,544	3.8
30. Tanning materials, natural dyestuffs, mordants, assistants, and sizes	42,164,716	159,771	3.8
31. Condensed and evaporated milk	209,755,891	743,372	3.5
32. Dyeing and finishing cotton, rayon, silk, and linen textiles	271,167,139	955,516	3.5

Source: *Census of Manufactures*, 1939.

this with other factors in the making of actual locational decisions. Industries in which such orientation may possibly exist are indicated by tables 7, 8, and 9, which show the most intensive consumers (in terms of physical units per dollar value of product) of bituminous coal, fuel oil, and natural gas, respectively.

The industries here listed in fact vary widely in their tendency toward fuel orientation.[14] Those in which fuel orientation is clearly the dominant factor are the consumers of fuels as raw materials: Coke ovens and bituminous coal; carbon black and natural gas; and (to a lesser extent) petroleum refineries and crude oil. In a second and far larger class, fuel has clearly played a major role in plant location, along with consideration of raw materials and markets. This class would include glass (natural gas); clay products (coal or gas); metal refining and fabrication and chemicals (coal and gas). In a third class, materials and markets are of dominant importance, but materials are so widely available that fuel costs are enabled to play some part in locational decisions: paper, cement, and lime fall in this category. In a fourth class, finally, other factors are of such overwhelming importance that the locational significance of fuels is negligible despite the heavy consumption. Cases in point are manufactured ice (market-oriented), and naval stores and salt (material oriented). In importance of secondary locational effects, exercised indirectly through the medium of fuel-oriented industries, coal far outranks the other fuels.

Table 8.—*Consumption of fuel oil in selected manufacturing industries, 1939*

Industry	Value of product	Fuel oils (barrels)	Barrels fuel oil consumed per $1,000 value of product
All industries	$56,828,807,223	133,773,524	2.4
1. Brick and hollow structural tile	78,153,227	1,532,530	19.6
2. Gypsum products	46,211,980	875,942	18.9
3. Terra cotta	3,175,310	55,893	17.6
4. Petroleum refining	2,461,126,549	37,156,306	15.1
5. Fish and other marine oils, cake and meal	13,622,312	169,721	12.5
6. Cane sugar, except refineries	33,526,898	408,061	12.2
7. Cement	192,611,304	2,352,493	12.2
8. Dyeing and finishing cotton, rayon, silk and linen textiles	271,167,139	3,281,679	12.1
9. Paving blocks and paving mixtures: asphalt, creosoted wood, and composition	32,754,308	392,243	12.0
10. Forgings, iron and steel, made in plants not operated in connection with rolling mills	104,883,196	1,201,879	11.5
11. Vitreous-china plumbing fixtures	21,978,821	240,278	10.9
12. Mineral wool	8,237,553	24,038	10.2
13. Pulp goods (pressed, molded)	3,826,393	36,190	9.5
14. Lime	36,971,171	315,991	8.5
15. Blast furnaces products—steel works and rolling mills	3,270,821,877	27,387,058	8.4
16. Woolen and worsted manufactures—contract factories	13,156,533	109,614	8.3
17. Steam and other packing; pipe and boiler covering	37,170,483	301,161	8.1
18. Colors and pigments	83,885,847	664,866	7.9
19. Chemicals not elsewhere classified	839,750,366	6,574,231	7.8
20. Enameling, japanning and lacquering	6,935,646	53,149	7.7
21. Sewer pipe and kindred products	18,295,679	132,179	7.2
22. Steel castings	135,466,423	960,970	7.1
23. Ice manufactured	130,166,312	874,317	6.7
24. Coal-tar products, crude and intermediate	42,917,034	277,156	6.5
25. Files	11,293,946	73,679	6.5
26. Glue and gelatin	34,331,639	219,863	6.4
27. Cork products	17,723,584	110,690	6.2
28. Dyeing and finishing woolen and worsted	37,437,032	224,773	6.0
29. Malt	58,478,581	346,887	5.9
30. Explosives	17,053,206	395,173	5.6
31. Hardwood distillation and charcoal manufacture	6,843,172	38,605	5.6
32. Paper and paperboard mills—Pulp mills	1,159,867,486	6,212,799	5.4
33. Hat bodies and hats, fur-felt	39,500,929	206,699	5.2
34. Glass containers	158,271,647	795,200	5.0
35. Springs, steel (except wire), made in plants not operated in connection with rolling mills	23,044,252	116,232	5.0

Source: *Census of Manufactures*, 1939.

[14] In this connection, the reader's attention is called to two convenient sets of maps showing the location of specific industries. A publication of the Department of Commerce, Bureau of the Census, entitled, *Maps of Selected Industries Reported to the Census of Manufactures, 1937* (1941), shows location of establishments, wage earners, and value added by manufacture for 39 industries. Of particular relevance to the present discussion are blast-furnace products, p. 11; steel works and rolling mills, p. 121; chemicals, p. 21; glass, p. 48; paper, p. 94; and pottery and china firing, p. 101. The National Resources Committee, in *The Structure of the American Economy*, maps the location of establishments in selected industries in 1935. Particular attention is called to coke-oven products, p. 49; cement, p. 40; pulp, p. 54; and clay products, p. 357; as well as a number of industries also mapped in the Census publication. The indicated locations may be compared with the location of coal, oil, and gas production as shown in figure 67, herein.

TABLE 9.—*Consumption of natural gas in manufacturing industries, 1939*

Industry	Value of product	Natural gas (M cubic feet)	Cubic feet of natural gas consumed per $1,000 value of product
All industries	$56, 828, 807, 223	881, 830, 178	15. 5
1. Bone black, carbon black and lampblack	14, 626, 876	247, 254, 149	16, 904. 0
2. Roofiug tile	1, 824, 881	1, 519, 042	832. 4
3. Cement	192, 611, 304	40, 288, 161	209. 2
4. Tableware, pressed or blown glass and glassware not elsewhere classified	97, 317, 363	19, 001, 375	195. 3
5. Brick and hollow structural tile	78, 153, 227	15, 254, 208	195. 2
6. Glass containers	158, 271, 647	28, 202, 009	178. 2
7. Flat glass	102, 389, 012	16, 307, 376	159. 3
8. Salt	27, 530, 172	4, 371, 145	158. 8
9. Sewer pipe and kindred products	18, 295, 679	2, 456, 778	134. 3
10. Floor and wall tile (except quarry tile)	17, 658, 885	2, 226, 524	126. 1
11. Hardwood distillation and charcoal manufacture	6, 843, 172	837, 060	122. 3
12. Clay refractories, including refractory cement (clay)	42, 191, 454	4, 873, 605	115. 5
13. Pottery products not elsewhere classified	16, 593, 344	1, 820, 484	109. 7
14. Wallboard and wall plaster (exc. gypsum) building insulation (except mineral wool) and floor composition	35, 753, 840	3, 647, 113	102. 0
15. Hotel china	9, 359, 660	783, 006	83. 7
16. Whiteware	27, 800, 677	2, 159, 169	77. 7
17. Terra cotta	3, 175, 310	218, 393	68. 8
18. Lime	36, 971, 171	2, 491, 750	67. 4
19. Wood naval stores	14, 114, 193	906, 090	64. 2
20. Mineral wool	8, 237, 553	451, 885	54. 9
21. Clay products (except pottery) not elsewhere classified	4, 450, 202	235, 900	53. 0
22. Custom slaughtering, wholesale	1, 932, 722	99, 540	51. 5
23. Oypsum products	46, 241, 980	2, 355, 789	50. 9
24. Petroleum refining	2, 461, 126, 549	115, 842, 098	47. 1
25. Chemicals not elsewhere classified	839, 750, 366	37, 741, 344	44. 9
26. Carbon products for the electrical industry, and manufactures of carbon or artificial graphite	18, 375, 580	756, 225	41. 2
27. Ice, manufactured	130, 166, 312	5, 033, 573	38. 7
28. Photographic apparatus and materials and projection equipment (except lenses)	133, 899, 429	4, 584, 813	34. 2
29. Minerals and earths, ground or otherwise treated	38, 903, 146	1, 303, 773	33. 5
30. Enameling, japanning, and lacquering	6, 935, 646	228, 897	33. 0
31. Porcelain electrical supplies	20, 817, 045	654, 500	31. 4
32. Blast-furnace products—Steel works and rolling mills	3, 270, 821, 877	102, 032, 341	31. 2
33. Primary smelting and refining of nonferrous metals	956, 572, 486	29, 469, 975	30. 8

SOURCE: *Census of Manufactures, 1939.*

Little information is available to show the influence of fuels on the location of individual plants. Occasionally, however, this factor is emphasized in particular locational decisions. One striking example is the selection by the International Nickel Co. of Huntington, W. Va., as the location for a nickel refinery and rolling mill, constructed in 1922. In an intensive study, by the management, of the relative importance of various locational factors, fuels were given a weight of 330, as against 250 for labor, 100 for power, 100 for living conditions, 60 for supplies, 50 for climate, 50 for transportation, 20 for taxes and laws, 20 for construction costs, 10 for water supply, and 10 for character of available site. "A plentiful supply of natural gas," it was said, "and the certainty of indefinite supplies of good quality low-sulphur bituminous coal, to replace gas and oil when this necessity arises, insure low fuel costs for the industry. The present and prospective future power development at hydroelectric stations also was strongly in favor of this location." [15]

Over recent decades, interfuel competition has favored natural gas and oil at the expense of coal, and has undoubtedly contributed substantially to the noticeable southward drift of heavy fuel-consuming industries. For direct heating or steam raising, the three major fuels are readily substitutable for one another, and the selection of fuel at a given location is generally simply a matter of delivered price plus costs of handling, burning, and waste disposal. Even at the same cost, however, the greater convenience and cleanliness of the petroleum fuels and the greater ease of heat control in special thermal processing may make the latter preferable.

The relative importance of the various fuels in different areas, which has been discussed in general terms in connection with figure 67, is shown more precisely in table 10 and in the accompanying pie map, figure 69. This map shows clearly the predominant use of natural gas in areas with low-cost surpluses, the limitation of fuel oil to regions accessible by water transportation, and the rapid decrease in importance of coal with increasing distance from the fields. Increased industrial utilization of natural gas in the Southwest is paralleled in contemporary locational significance only by the growth of electroprocess industries near low-cost water power. In the chemicals industry particularly, the Gulf coast has witnessed a rapid development since the close of World War I. As one authority puts it: "Petroleum and natural gas in close association with essential raw materials and adjacent to seaboard or rivers where cheap water transportation is afforded to both domestic and foreign markets—that is the practically unbeatable combination responsible for so much of the recent industrial development of the Southwest." [16] A similar but less extensive development has occurred in southern California. The net effect of interfuel competition is not so much a displacement of older plants from the coal regions as a dispersion of fuel-consuming industries through the location of new units in the natural-gas areas.

The Trend Toward Electrification

Even more marked than the shift in emphasis from coal to other fuels is the trend toward increasing utilization of energy in the form of electricity. As shown in tables 1 and 2, the proportion of purchased electricity to total energy consumption in manufacturing industries has risen from 3.5 percent in 1909 to 12.7

[15] R. S. McBride, "Quantity Methods in Production of Quality Metals and Alloys," *Chemical and Metallurgical Engineering*, Vol. 29, Oct. 22, 1923, p. 746.

[16] Editorial, *Chemical and Metallurgical Engineering*, Vol. 41, August 1934, p. 397.

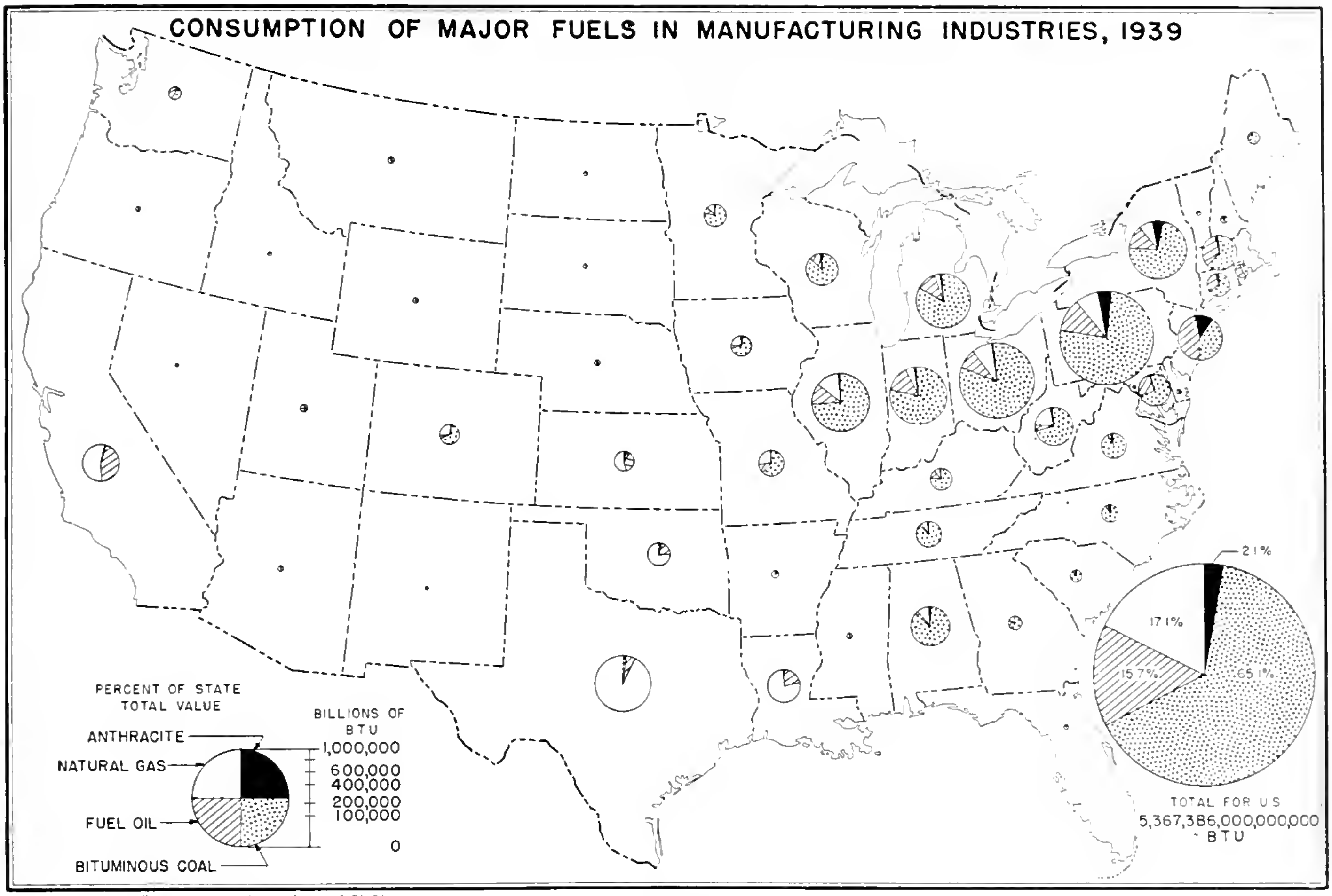

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FIGURE 69

percent in 1939 in terms of physical quantity, and from 10.5 percent to 35.3 percent in terms of cost. The extent of electrification is more far-reaching than is indicated by these figures, since a substantial share of the fuel consumption goes into the production of plant-generated electricity. In 1939, the only year for which data on the subject were obtained by the Census, the quantity of plant-generated energy consumed in manufacturing industries amounted to 25,827 million kilowatt-hours, bringing the share of electricity in total physical energy consumption to 20 percent. The cost of fuel consumed in plant generation of electricity in 1939 is estimated at $66,000,000, raising the share of electricity in total energy costs to over 40 percent.[17]

[17] Estimated by allocating plant-generated energy between fuel and water power in proportion to the capacity of fuel-operated and hydroelectric generators in the plants; converting the estimate for fuel-generated energy to bituminous coal at the conversion factor used in table 1 and to Btu at the conversion factor used in table 10; converting to dollars at the average cost of all fuels used in manufacturing industries. The estimate probably errs on the conservative side since the average efficiency of fuel conversion to electric energy in manufacturing plants is undoubtedly considerably less than in central generating stations.

So far as motive power alone is concerned, the increase in importance of purchased energy is even more rapid, as is shown by table 11 and figure 70. The increase in mechanization indicated by the rapid rise in horsepower per wage earner, tabulated in the last column of table 11, has been paralleled since the turn of the century by a very marked increase in both absolute and relative importance of equipment driven by purchased energy. The relation of such equipment to other types of horsepower equipment is charted in figure 71.[18] Figure 72, which shows the horsepower of electric motors in manufacturing industries, again demonstrates the increasing importance of purchased energy in the over-all picture.

The locational significance of this trend toward electrification is manifold. The increasing use of energy

[18] The data as tabulated to some extent overstate the shift, since horsepower of motors run by purchased energy is being compared with horsepower of prime movers within the plant, and diversity of use over time permits the operation of more than one motor horsepower per horsepower of prime mover. No precise evaluation of the degree of overstatement is possible, but it is believed small in comparison with the indicated trends.

TABLE 10.—*Consumption of fuels in manufacturing industries, 1939, by States, Btu equivalents*

[Quantities in billions of Btu]

	Total quantity	Anthracite [1]		Bituminous coal [2]		Fuel oil [3]		Natural gas [4]	
		Quantity	Percent	Quantity	Percent	Quantity	Percent	Quantity	Percent
United States	5,367,386	111,405	2.1	3,492,495	65.1	841,974	15.7	921,512	17.1
New England	285,518	6,419	2.2	181,303	63.5	97,796	34.3		
Maine	28,312	133	.5	21,117	74.6	7,062	24.9		
New Hampshire	13,700	600	4.4	10,368	75.7	2,732	19.9		
Vermont	4,493	466	10.4	3,498	77.8	529	11.8		
Massachusetts	139,856	2,798	2.0	87,914	62.9	49,144	35.1		
Rhode Island	32,725	222	.7	13,917	42.5	18,586	56.8		
Connecticut	66,404	2,177	3.3	44,489	67.0	19,738	29.7		
Middle Atlantic	1,565,601	89,751	5.7	1,113,220	71.1	269,157	17.2	93,473	6.0
New York	392,241	20,655	5.3	292,108	74.5	53,461	13.6	26,017	6.6
New Jersey	224,578	26,341	11.7	92,756	41.3	105,481	47.0		
Pennsylvania	948,758	42,732	4.5	728,356	76.8	110,214	11.6	67,456	7.1
East North Central	1,715,751	8,218	.5	1,391,842	81.1	196,467	11.5	119,224	6.9
Ohio	610,157	2,332	.4	500,637	82.0	53,688	8.8	53,500	8.8
Indiana	342,694	444	.1	278,799	81.4	48,665	14.2	14,786	4.3
Illinois	344,305	1,888	.5	258,190	75.0	41,943	12.2	42,284	12.3
Michigan	316,208	2,243	.7	263,513	83.3	41,798	13.2	8,654	2.8
Wisconsin	102,414	1,333	1.3	90,702	88.6	10,379	10.1		
West North Central	218,370	1,866	.9	121,300	55.5	31,722	14.5	63,482	29.1
Minnesota	52,637	244	.5	40,966	77.8	4,897	9.3	6,530	12.4
Iowa	40,037	333	.8	28,341	70.8	1,467	3.7	9,896	24.7
Missouri	68,980	311	.4	42,791	62.0	8,182	11.9	17,696	25.7
North Dakota	2,118			1,876	88.6	101	4.8	141	6.6
South Dakota	3,071			811	26.4	126	4.1	2,134	69.5
Nebraska	10,203	22	.2	4,081	40.0	950	9.3	5,150	50.5
Kansas	41,343	955	2.3	2,459	5.9	15,993	38.7	21,936	53.1
South Atlantic	452,176	3,487	.8	342,580	75.8	68,510	15.1	37,599	8.3
Delaware	12,147	155	1.3	4,487	36.9	7,502	61.8	3	
Maryland	111,557	733	.6	83,452	74.8	26,951	24.2	421	.4
District of Columbia	1,846	67	3.6	684	37.1	1,095	59.3		
Virginia	67,052	244	.4	63,426	94.6	3,229	4.8	152	.2
West Virginia	152,178	244	.1	112,731	74.1	7,144	4.7	32,059	21.1
North Carolina	36,270	1,644	4.5	33,462	92.3	1,164	3.2		
South Carolina	29,469	200	.7	25,933	88.0	3,336	11.3		
Georgia	28,290	133	.5	17,669	62.5	6,319	22.3	4,169	14.7
Florida	13,393	67	.5	761	5.7	11,770	87.9	795	5.9
East South Central	309,013	711	.2	263,336	85.2	13,815	4.5	31,151	10.1
Kentucky	54,687	133	.2	43,501	79.6	6,955	12.7	4,098	7.5
Tennessee	59,843	466	.8	53,387	89.2	1,504	2.5	4,486	7.5
Alabama	182,439	67		161,302	88.4	4,003	2.2	17,067	9.4
Mississippi	12,050	44	.4	5,146	42.7	1,360	11.3	5,500	45.6
West South Central	510,948	577	.1	5,374	1.0	55,998	11.0	448,999	87.9
Arkansas	15,915	133	.9	1,115	7.0	1,422	8.9	13,245	83.2
Louisiana	104,949	44	.1	456	.4	22,274	21.2	82,175	78.3
Oklahoma	53,086			1,749	3.3	11,065	20.8	40,272	75.9
Texas	336,974	378	.1	2,053	.6	21,236	6.3	313,307	93.0
Mountain	123,612	222	.2	61,094	49.4	18,284	14.8	44,012	35.6
Montana	14,014	22	.2	4,183	29.8	1,605	11.5	8,204	58.5
Idaho	5,082	22	.4	4,512	88.8	548	10.8		
Wyoming	9,855			2,358	23.9	3,097	31.4	4,400	44.7
Colorado	49,290	67	.1	32,955	66.9	1,913	3.9	14,355	29.1
New Mexico	3,320			532	16.0	579	17.5	2,209	66.5
Arizona	9,945	111	1.1	558	5.6	2,813	28.3	6,463	65.0
Utah	28,858			13,410	46.5	7,068	24.5	8,380	29.0
Nevada	3,247			2,586	79.6	661	20.4		
Pacific	186,368	155	.1	12,422	6.7	90,218	48.4	83,573	44.8
Washington	24,456	89	.4	11,129	45.5	13,224	54.1	14	.0
Oregon	7,626	22	.3	1,115	14.6	6,489	85.1		
California	154,284	44	.0	177	.1	70,505	45.7	83,558	54.2

SOURCE: Computed from data in *Census of Manufactures*, 1939.

[1] Anthracite converted at 22.21 million Btu per ton.

[2] Bituminous coal converted at 25.35 million Btu per ton. There is a substantial variation in the heat content of different coals, which is not taken into account in these figures. Lignite, in particular, averages about 14.9 million Btu per ton, compared with 25.4 million Btu for bituminous coal. The figures for coal consumption in areas using low-grade coals are therefore somewhat inflated, and for those using high-grade coals deflated.

[3] Fuel oil converted at 6.294 million Btu per barrel.

[4] Natural gas converted at 1.045 million Btu per thousand cubic feet.

in the form of electricity entails a correspondingly increased tendency toward power orientation. The increasing proportion of electric energy purchased from central stations, rather than generated at the plants, gives added weight to geographical differentials in industrial power rates, which by no means follow the pattern of fuel costs. Electrification restores water power to a position of importance as a locational factor, permitting direct competition of this energy resource with the fuels. At the same time, the most intensive consumers of power are a highly specialized group of industries. Power orientation, therefore, deserves analysis apart from that based on the other energy sources.

Orientation Toward Power

Analysis of power orientation is complicated by the fact that manufacturing plants themselves generate a substantial portion of the industrially consumed electric energy, and no cost data are available

TABLE 11.—*Power equipment in manufacturing industries, 1849–1939* [1]

Year	Steam engines and turbines		Internal combustion engines		Hydroturbines and water wheels		Equipment drive by purchased energy		Total		Horsepower per wage earner
	Horsepower (thousands)	Percent	Horsepower (thousands)	Percent	Horsepower (thousands)	Percent	Horsepower (thousands)	Percent	Horsepower (thousands)	Percent	
1849 [2]	450	40.9			650	59.1			1,100	100.0	1.15
1859 [2]	700	43.7			900	56.3			1,600	100.0	1.22
1869	1,216	51.8			1,130	48.2			2,346	100.0	1.11
1879	2,185	64.1			1,225	35.9			3,410	100.0	1.25
1889	4,586	77.2	9	0.2	1,255	21.1	89	1.5	5,939	100.0	1.40
1899	8,190	81.1	135	1.3	1,454	14.4	320	3.2	10,099	100.0	2.24
1904	10,918	82.1	289	2.2	1,647	12.4	442	3.3	13,296	100.0	2.56
1909	14,229	76.2	751	4.0	1,823	9.8	1,873	10.0	18,676	100.0	2.98
1914	15,591	69.9	989	4.4	1,826	8.2	3,885	17.5	22,291	100.0	3.37
1919	17,040	57.7	1,259	4.3	1,765	6.0	9,443	32.0	29,507	100.0	3.50
1923	16,701	50.5	1,224	3.7	1,803	5.4	13,365	40.4	33,093	100.0	4.03
1925	16,917	47.3	1,186	3.3	1,801	5.0	15,869	44.4	35,773	100.0	4.54
1927	16,924	43.6	1,171	3.0	1,599	4.1	19,132	49.3	38,826	100.0	4.94
1929	17,362	40.4	1,234	2.9	1,560	3.6	22,776	53.1	42,932	100.0	5.12
1939	17,860	34.9	1,813	3.5	1,604	3.1	29,888	58.5	51,165	100.0	6.48

SOURCE: *Census of Manufactures.*

[1] Variations in classification in different census years prevent these data from being perfectly comparable. The effect upon comparability of the United States totals, however, is insignificant, and has been neglected in this tabulation. For a discussion of this point, see W. L. Thorp, "Horsepower Statistics for Manufactures." *Journal of the American Statistical Association*, Vol. 24, pp. 376–385 (December 1929).

[2] Estimated by C. R. Daugherty, in *The Development of Horsepower Equipment in the United States*, U. S. Geological Survey, Water Supply Paper 579 (1928), p. 49.

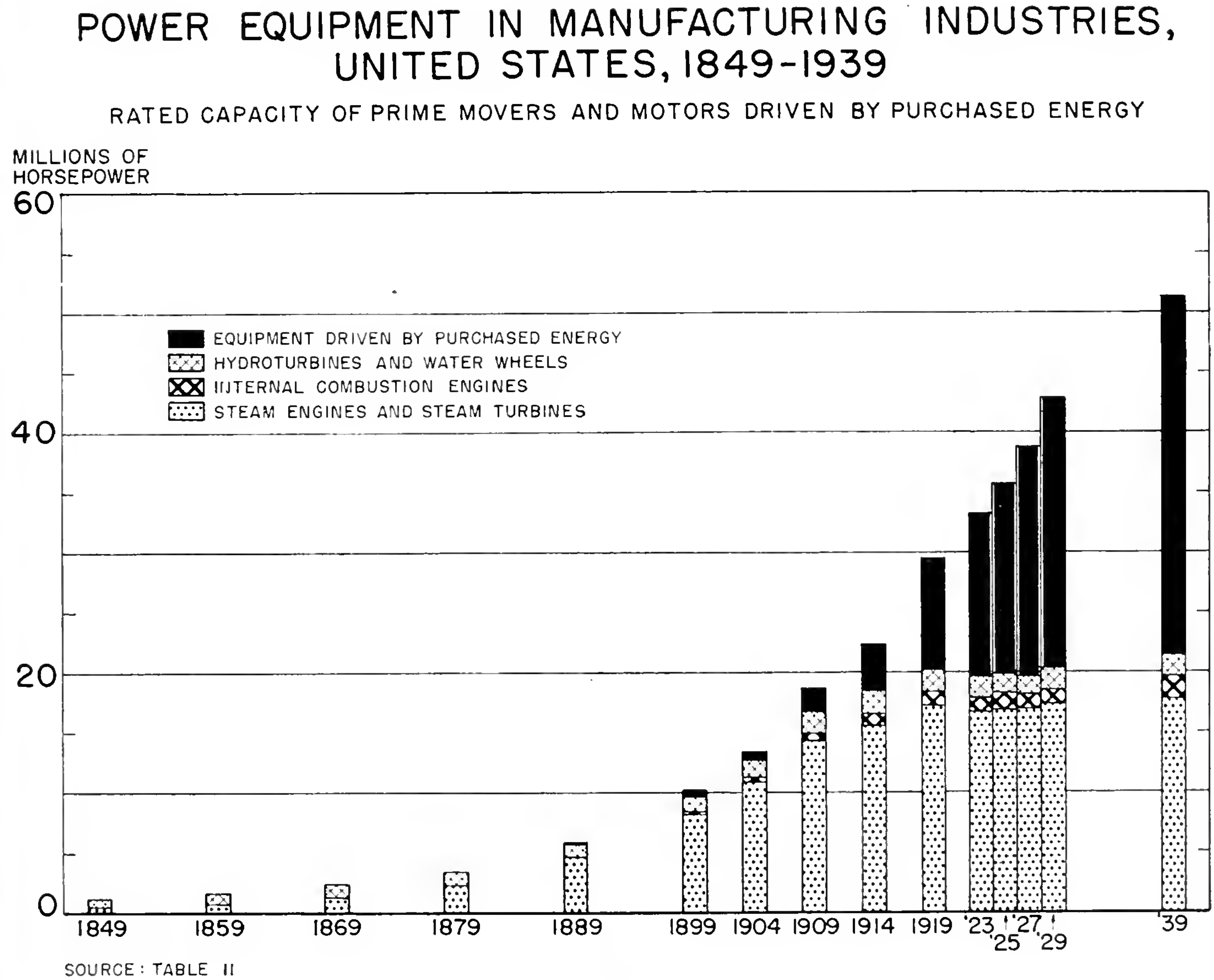

FIGURE 70

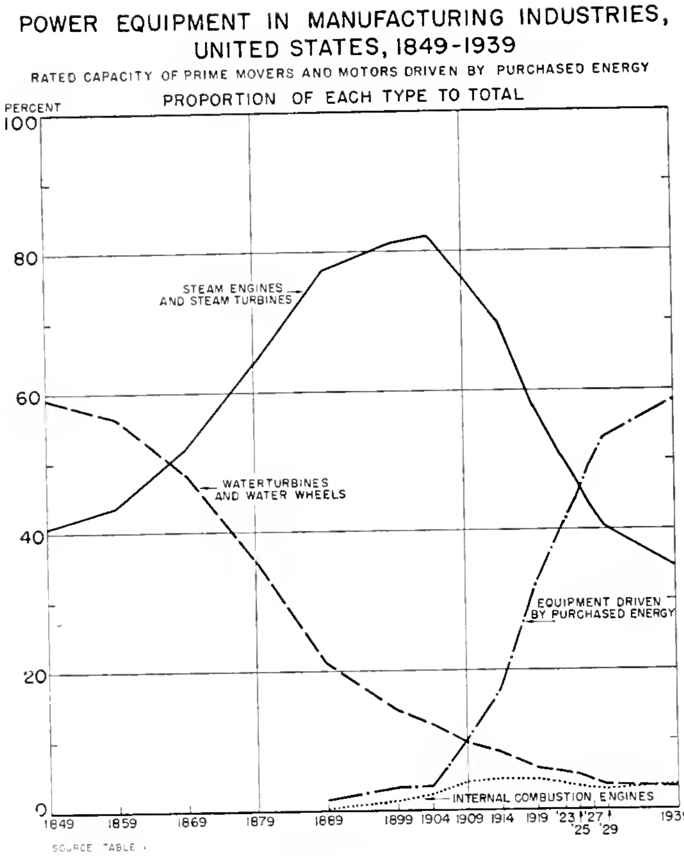

FIGURE 71

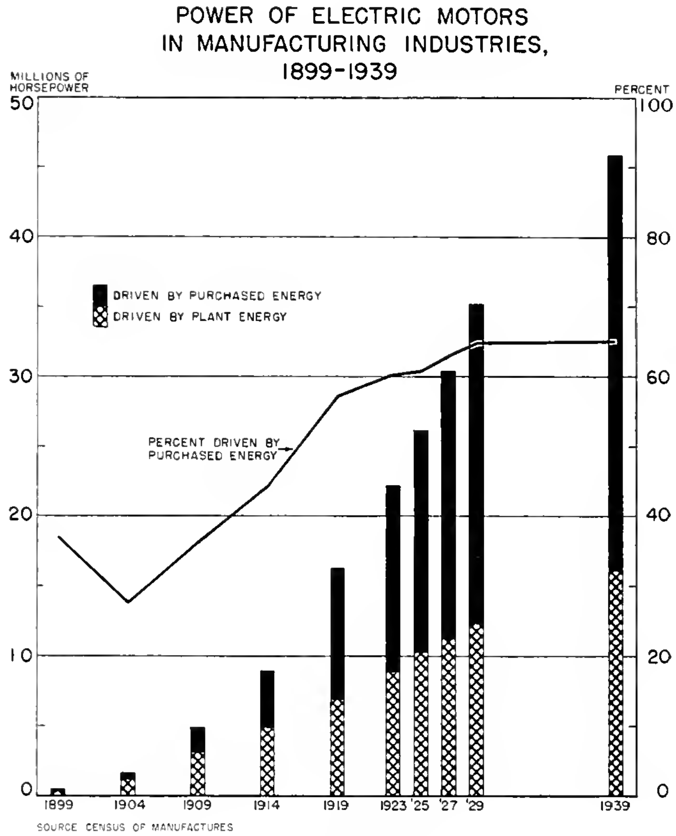

FIGURE 72

for this portion. In 1939, this quantity amounted to 25,827 out of a total of 70,868 million kilowatt-hours, or 36.5 percent. For light consumers of power, purchase from central stations is almost always more economical than self-generation, and is preferred even at a slightly unfavorable cost differential in order to leave the risks of mechanical trouble and of changes in fuel and labor costs to be borne by the utility companies. For heavier consumers, self-generation is usually preferred where exhaust steam can be used for heat processing or water-gas manufacture, where wood waste, sawdust, or other fuels are available as byproducts, or where the local central station supply is inadequate or unobtainable on reasonable terms. The leading industries in which reliance is placed upon plant generation for a large part of the energy needs are shown in table 12. While allowance must be made for possible differences in any given area between the price of central-station energy and the cost of plant generated energy, such differences are probably very small for the bulk of industry. The alternative costs of self-generation by manufacturers, in fact, play a leading role in determining industrial power rates. Outstanding cases of large cost differentials exist in some mountainous regions, where the limited water-power sites have all been developed by large power-using industries. For the most part, however, areas with low costs of self-generation also enjoy low industrial power rates.

The geographical pattern of industrial power rates, shown in figure 74,[19] displays a number of striking contrasts with the pattern of fuel costs presented in figure 7. There are, to be sure, large regions where low fuel costs and low electric rates go hand in hand. For the most part, however, there is no such consistent relationship. The dominant factor in the two lowest rate groups, below 8 mills per kilowatt-hour, is water power, and water power rivals natural gas in determining the location of the third class, 8 to 10 mills. In the great coal fields, as well as much of the oil and gas country, the prevailing rates range upwards of 10 mills.

[19] The rates shown are for a billing demand of 1,000 kilowatts and monthly consumption of 400,000 kilowatt-hours, representing a load factor of 62.5 percent. The areas mapped include all communities of 10,000 or more population, with contiguous service areas and selected intermediate areas. The rates shown are for unrestricted service, not dependent upon off-peak use or other special allowance, and have been adjusted for comparability. The geographical rate relationships would be only slightly altered by the selection of other demand and consumption bases, although the absolute level would be raised or lowered. In interpreting these data, it should be remembered that a considerable fraction of industrial energy is purchased under special contract rather than at regular published rates. Cf. Federal Power Commission, Electric Rate Survey, Rate Series No. 4, *Rates for Electric Service to Commercial and Industrial Customers* (1936), part 2.

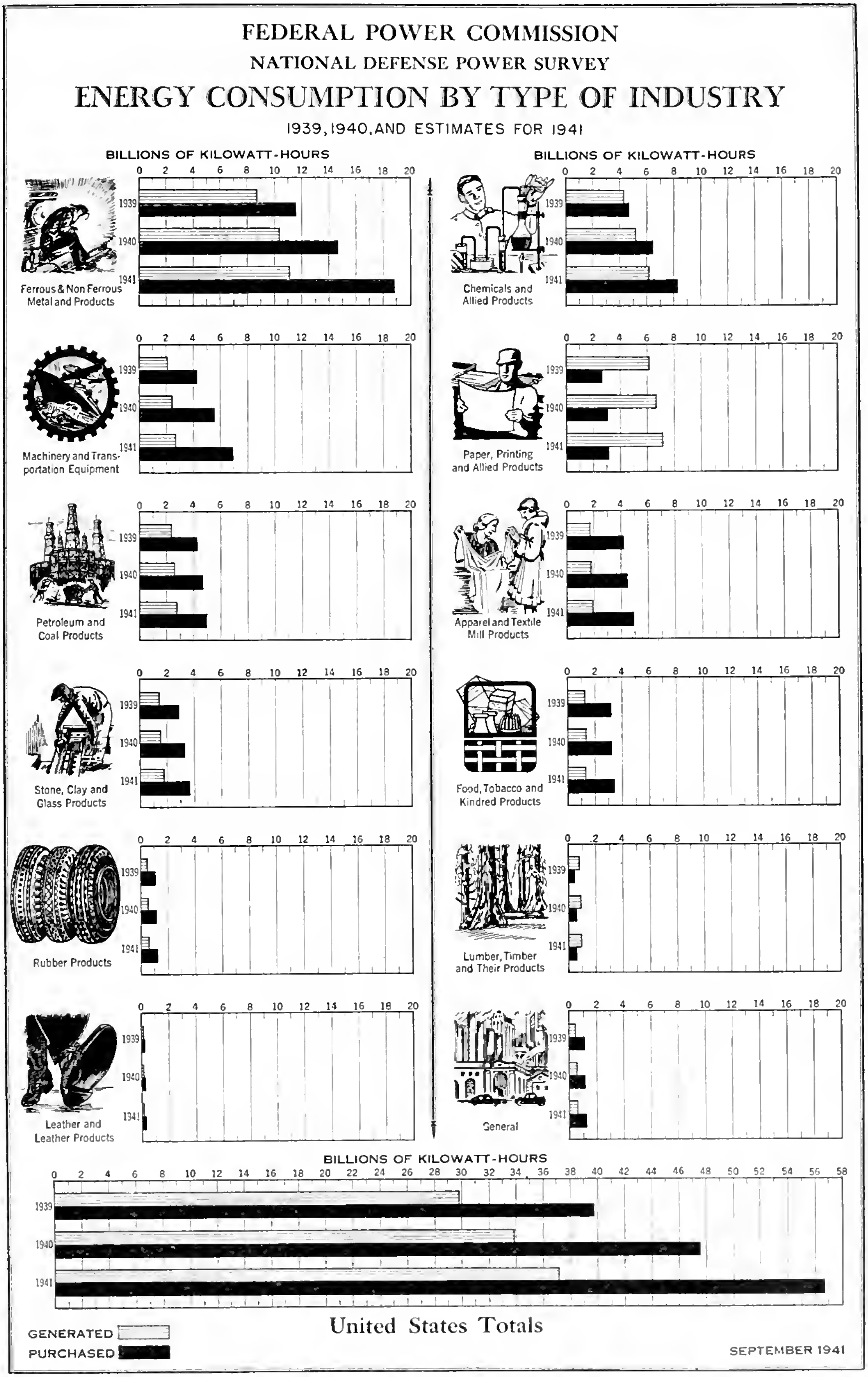
FEDERAL POWER COMMISSION
NATIONAL DEFENSE POWER SURVEY
ENERGY CONSUMPTION BY TYPE OF INDUSTRY
1939, 1940, AND ESTIMATES FOR 1941
BILLIONS OF KILOWATT-HOURS
Ferrous & Non Ferrous Metal and Products
Chemicals and Allied Products
Machinery and Transportation Equipment
Paper, Printing and Allied Products
Petroleum and Coal Products
Apparel and Textile Mill Products
Stone, Clay and Glass Products
Food, Tobacco and Kindred Products
Rubber Products
Lumber, Timber and Their Products
Leather and Leather Products
General
United States Totals
GENERATED
PURCHASED
SEPTEMBER 1941

Figure 73

TABLE 12.—*Plant generation and purchases of electric energy in selected manufacturing industries (1939)*

[Quantities in millions of kilowatt-hours]

	Plant generated	Sold	Net plant generated	Purchased	Total	Proportion plant generated
						Percent
All industries	28,750.0	2,923.0	25,827.0	45,040.9	70,867.9	36
Cane sugar refining	200.7	4.9	195.8	5.8	201.6	97
Corn sirup, corn sugar, corn oil and starch	284.8		284.8	17.4	302.2	94
Beet sugar	149.3	11.2	138.1	11.6	149.7	92
Cane sugar (except refineries)	14.3	.4	13.9	2.2	16.1	86
Rayon and allied products	1,031.5	4.5	1,027.0	211.9	2,238.9	83
Salt	55.8	2.3	53.5	12.0	65.5	82
Glue and gelatin	44.4	1.3	43.1	11.9	55.0	80
Matches	25.7		25.7	7.5	33.2	77
Tanning materials, etc	33.4	.1	33.3	11.2	44.5	75
Hardwood distillation and charcoal manufacture	11.1	.1	11.0	3.8	14.8	74
Internal-combustion engines	55.0	4.1	50.9	21.9	72.8	70
Saw-mills, etc	824.8	169.7	655.1	312.4	967.5	68
Communication equipment	83.1		83.1	39.7	122.8	68
Ammunition	16.8	1.9	14.9	6.9	21.8	68
Paper and pulp mills	6,297.9	210.5	6,087.4	2,973.0	9,060.4	67
Jute goods (except felt)	26.2		26.2	14.3	40.5	65
Coal-tar products	33.5		33.5	20.0	53.5	63
Dyeing and finishing, wool	15.4	4.6	10.8	7.1	17.9	60
Cigarettes	44.5	3.3	41.2	29.6	70.8	58
Steam and other packing; pipe and boiler covering	20.0	.1	19.9	17.8	37.7	57
Carpets and rugs, wool	40.3	1.4	47.9	38.7	96.6	55
Dyeing and finishing, cotton, rayon, silk, and linen	195.8	23.7	172.1	146.5	318.6	54
Chocolate and cocoa	80.2	11.2	69.0	58.0	127.0	54
Liquors, distilled	35.9	4.6	31.3	26.6	57.9	54
Soap and glycerine	61.0		61.0	53.6	114.6	53
Wood naval stores	337.9	14.1	323.8	288.7	612.5	52
Photographic apparatus	90.7	37.0	53.7	51.2	104.9	51
Generating, distribution and industrial apparatus, electrical	249.8	23.5	226.3	237.1	463.4	49
Cement	1,319.2	21.0	1,298.2	1,402.4	2,700.6	48
Blast furnace products; steel works and rolling mills	5,680.1	1,349.6	4,330.5	5,119.0	9,449.5	46
Petroleum refining	1,339.2	71.5	1,267.7	1,505.1	2,772.8	46
Chemicals, not elsewhere classified	2,873.1	142.8	2,730.3	3,806.0	6,536.3	42
Motor vehicles	1,174.4	128.3	1,046.1	1,420.0	2,466.1	42
Beehive coke	3.8	1.9	1.9	2.8	4.7	40
Primary smelting and refining of nonferrous metals	1,232.4	304.9	927.5	3,694.3	4,621.8	20

SOURCE: *Census of Manufactures, 1939.*

The outstanding feature of this picture is its haphazard character. Low and high rate areas are intermingled without apparent reason. Rates below 10 mills sometimes occur in areas devoid of cheap fuels or water power; rates far above 10 mills occur despite an abundance of cheap fuels. The structure as a whole can be understood only as a product of the accidents of utility policy and the strength of industrial bargaining, together with the occasional impact of state regulation or of public power projects.

The percentage range of power costs indicated in this sample is almost identical with that for fuels. Tacoma, Wash., at one end of the scale enjoys a rate of 4 mills per kilowatt-hour, while at North Attleboro, Mass., energy under comparable conditions is sold at 26.4 mills. The concentration of rates in the modal groups, however, i. e., 8 to 12 mills, is much greater than with fuels. In consequence, as might be expected, orientation toward power is less sharply marked than fuel orientation. A general measure of the degree of power orientation is presented in table 13 and figure 75, employing the same method of analysis as table 6 and figure 8. The inverse correlation between unit cost of purchased energy and consumption per wage earner is very high, the coefficient for all points being –.766 and for all but Arizona, Montana, Nevada, and Wyoming [20] almost –.80.[21] The indicated elasticity of demand, excluding the four Mountain States, is slightly more than unity. The degree of power orientation thus suggested, while considerably less than with fuels, is nonetheless very substantial.

Variations among particular industries in power needs, and consequently in tendency toward power orientation, are very marked. Consumption by industry groups has been shown in the last two columns of table 5; table 14 presents the leading power consumers among the Census industries, ranked in order of intensity of consumption. It is evident that in no industry here listed is power orientation the sole locational factor. In some, notably manufactured ice, market considerations are determining to the exclusion of all else. In others, such as cement, paper, and pulp goods, power costs are sufficiently influential on occasion to determine a choice between otherwise equally satisfactory locations. In the production of carbon products and compressed and liquified gases, power costs are a major factor, rivalling in importance both materials and markets.

In some instances, comparative power costs appear to play a larger role in locational decisions than is warranted by the actual importance of power to the industries concerned. Since power rates are a matter of public record, and are often more easily ascertained than other costs, cheap power readily assumes a disproportionately attractive aspect in the eyes of the site-seeking entrepreneur. This tendency is occasionally a subject for unfavorable comment in the trade literature.[22]

To find examples of industrial location where power is the sole central consideration, analysis must reach beyond the classification of the Census of Manufactures. The three broad Census groups, "Chemicals,

[20] These four Mountain States have an unusually high consumption per wage earner, regardless of cost, because of heavy power demands for the refining of mineral ores.

[21] This correlation might perhaps be attributed to the large quantity discounts characteristic of electric rate schedules. In fact, however, consumption per wage earner by States is only very slightly correlated with consumption per establishment. The correlation established in figure 75 must therefore be due primarily to the orientation of intensive consumers toward lower cost areas.

[22] See, for example, Ford Bates, "The Power-Cost Factor in Industry Location," *Electrical World*, Vol. 92, p. 456, September 8, 1926; also *Chemical and Metallurgical Engineering*, Vol. 48, p. 88, May 1941.

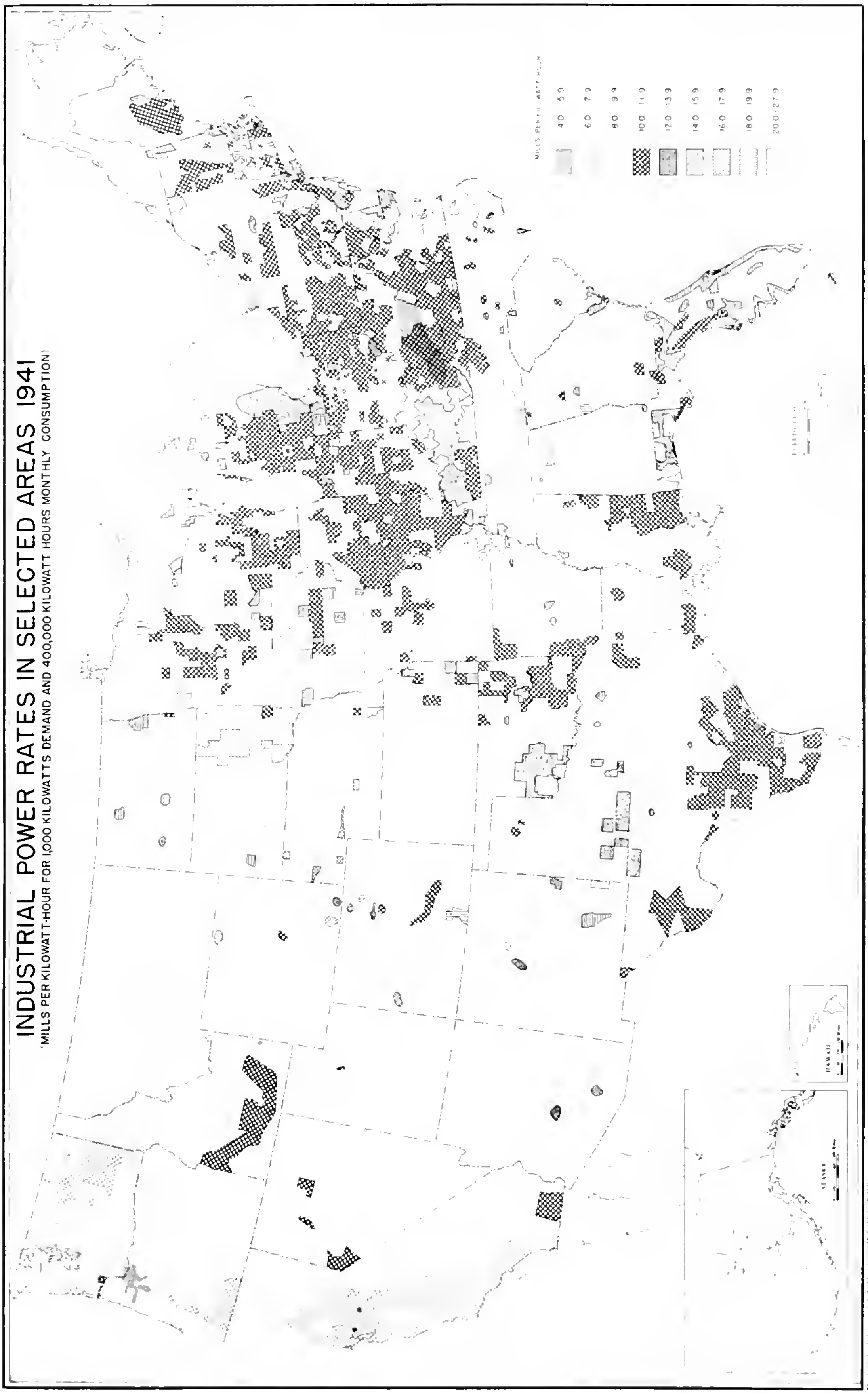
INDUSTRIAL POWER RATES IN SELECTED AREAS 1941
(MILLS PER KILOWATT-HOUR FOR 1,000 KILOWATTS DEMAND AND 400,000 KILOWATT HOURS MONTHLY CONSUMPTION)
40-59
60-79
80-99
100-119
120-139
140-159
160-179
180-199
200-279

FIGURE 74

TABLE 13.—*Consumption of purchased electric energy in manufacturing industries, 1939*

	Quantity purchased	Cost per kw.-hr.	Consumption per wage earner
	Kw.-hr.	*Cents*	*Kw.-hr.*
United States	45,040,075	1.03	5,711
GEOGRAPHIC DIVISIONS			
1. East South Central	3,787,107	.68	10,584
2. Mountain	1,065,388	.76	15,387
3. Pacific	3,263,467	.90	7,236
4. South Atlantic	5,694,100	.96	5,772
5. Middle Atlantic	12,949,780	.99	5,756
6. West South Central	1,960,990	1.02	7,468
7. East North Central	10,882,529	1.17	4,957
8. West North Central	2,051,200	1.25	5,367
9. New England	3,385,514	1.35	3,550
STATES			
1. Montana	573,743	.42	62,567
2. Tennessee	2,282,277	.48	17,306
3. Washington	935,014	.68	10,352
4. Idaho	135,541	.70	12,461
5. Maine	572,342	.74	7,565
6. Louisiana	609,400	.78	8,557
7. West Virginia	586,743	.80	7,843
8. New York	6,583,291	.88	6,872
9. South Carolina	932,458	.88	7,348
10. Alabama	1,067,563	.89	9,140
11. Oregon	387,363	.92	6,089
12. Nevada	22,968	.93	21,014
13. North Carolina	1,500,831	.95	5,554
14. Maryland	825,141	.97	5,825
15. Georgia	967,505	.99	6,131
16. California	1,941,090	1.01	6,535
17. Arizona	113,613	1.01	18,637
18. Pennsylvania	4,750,970	1.03	5,535
19. Virginia	591,023	1.03	4,414
20. Ohio	3,603,401	1.06	6,022
21. Iowa	460,977	1.09	7,058
22. Delaware	104,697	1.10	5,134
23. Texas	969,544	1.10	7,635
24. Kansas	280,712	1.11	8,879
25. Arkansas	183,110	1.13	5,051
26. Indiana	1,514,753	1.14	5,459
27. Mississippi	170,330	1.16	3,674
28. Michigan	2,500,564	1.17	4,788
29. Kentucky	266,937	1.21	4,251
30. Oklahoma	198,935	1.26	7,076
31. New Hampshire	175,082	1.27	3,139
32. Wisconsin	899,341	1.28	4,477
33. Missouri	727,009	1.28	4,072
34. Illinois	2,364,470	1.31	3,964
35. Nebraska	137,481	1.31	7,309
36. Utah	86,731	1.31	7,507
37. Wyoming	36,427	1.32	10,456
38. Minnesota	410,963	1.37	5,153
39. District of Columbia	39,634	1.37	5,030
40. New Jersey	1,615,519	1.37	3,727
41. Vermont	104,785	1.40	4,816
42. Rhode Island	378,448	1.42	3,561
43. Connecticut	687,276	1.49	2,943
44. Massachusetts	1,467,581	1.51	3,186
45. Florida	146,069	1.57	2,770
46. Colorado	86,442	1.77	3,645
47. South Dakota	23,726	1.97	4,284
48. New Mexico	9,925	2.36	3,054
49. North Dakota	10,326	2.65	3,916

SOURCE: Computed from data in *Census of Manufactures, 1939*.

COST OF PURCHASED ENERGY AND CONSUMPTION PER WAGE EARNER IN MANUFACTURING INDUSTRIES 1939, BY GEOGRAPHIC DIVISIONS AND STATES

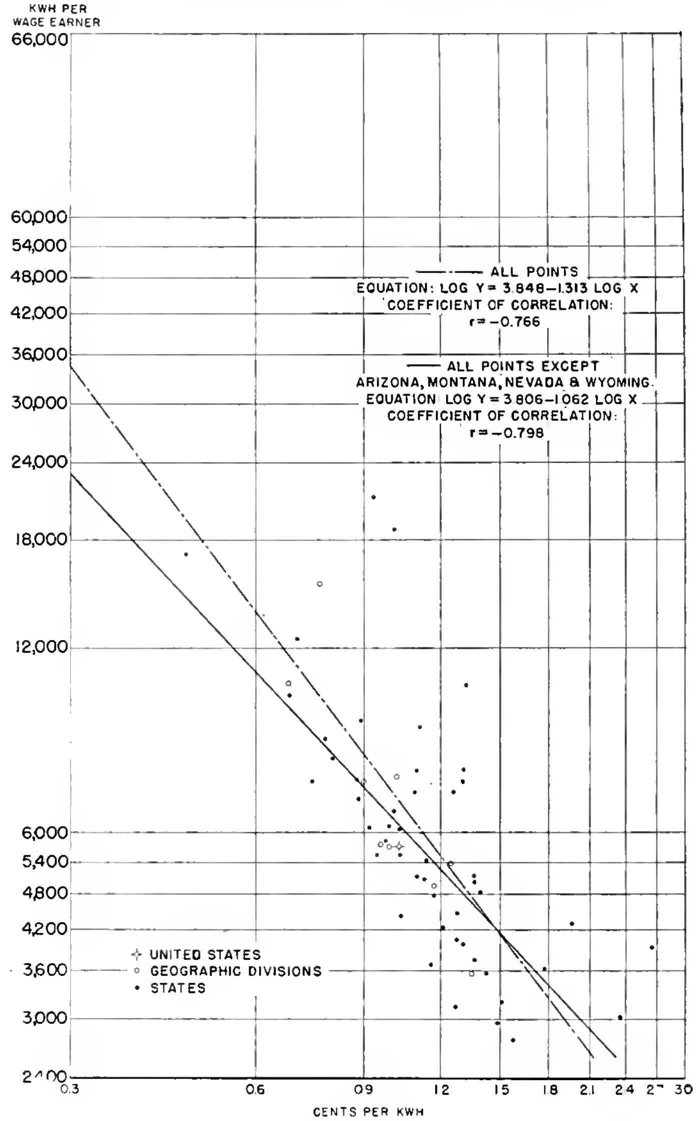

FIGURE 75

not elsewhere classified," "Primary smelting and refining of nonferrous metals," and "Blast-furnace products; steel works and rolling mills," although consuming on the average only 7.8, 4.1, and 2.9 kilowatt-hours per dollar value of product, respectively, contain a number of electroprocess industries for which power costs are always a prominent and often the exclusive locational consideration.[23] The extraordinarily high energy consumption relative to value of product for a number of leading electroprocess industries is shown in table 15. Other striking examples, for which production data are unavailable, are afforded by the two artificial abrasive materials, silicon carbide and fused alumina, for which the indicated energy consumption per dollar value of product is no less than 128.6 and 56.1 kilowatt-hours, respectively.[24] The major production of these materials is at low-cost hydroelectric power sites in Canada, whence they are imported into the United States for fabrication into grinding wheels, grindstones, and the like. Other important electroprocess industries are electric furnace

[23] For a general survey of these industries in relation to electric energy, see Federal Power Commission, *Power Requirements in Electrochemical, Electrometallurgical, and Allied Industries*, 1938. This publication contains a series of maps showing the location of the various electroprocess industries in 1937.

[24] Computed from *ibid.*, table 3, p. 14.

TABLE 14.—*Consumption of electric energy in selected manufacturing industries, 1939*

Industry	Value	Electric energy: Generated in plant	Electric energy: Sold	Electric energy: Purchased	Electric energy: Net consumption	Kilowatt-hours consumed per dollar of value of product
		Kw.-hr.	*Kw.-hr.*	*Kw.-hr.*	*Kw.-hr.*	
All industries	$56, 828, 807, 223	28, 749, 939, 758	2, 922, 939, 919	45, 040, 866, 703	70, 867, 866, 542	1. 2
1. Cement	192, 611, 304	1, 319, 235, 603	21, 049, 500	1, 402, 367, 970	2, 700, 554, 073	14. 0
2. Reclaimed rubber	6, 894, 018	2, 000, 000		81, 650, 137	83, 650, 137	12. 1
3. Pulp goods (pressed, molded)	3, 826, 393	1, 358, 798		43, 586, 522	44, 945, 320	11. 7
4. Ice manufactured	130, 166, 312	69, 551, 111	3, 996, 682	1, 359, 896, 132	1, 425, 450, 561	11. 0
5. Carbon products for the electrical industry and manufactures of carbon or artificial graphite	18, 375, 580			165, 436, 946	165, 436, 946	9. 0
6. Compressed and liquefied gases, not made in petroleum refineries or in natural gasoline plants	53, 364, 936	11, 182, 373		412, 547, 411	423, 729, 784	7. 9
7. Chemicals not elsewhere classified	839, 750, 366	2, 873, 105, 538	142, 750, 068	3, 805, 981, 195	6, 536, 336, 665	7. 8
8. Paper and paperboard mills, pulp mills	1, 159, 867, 486	6, 297, 943, 284	210, 499, 793	2, 972, 958, 641	9, 060, 402, 132	7. 8
9. Rayon throwing and spinning—contract factories	3, 066, 274	1, 519		20, 294, 264	20, 295, 783	6. 6
10. Wallboard and wall plaster (except gypsum), building insulation (except mineral wool) and floor composition	35, 753, 840	10, 943, 328		197, 482, 127	208, 425, 455	5. 8
11. Rayon and allied products	247, 065, 556	1, 031, 504, 701	4, 493, 635	211, 918, 743	1, 238, 929, 809	5. 0
12. Silk throwing and spinning and contract factories	15, 853, 452	2, 646, 750		74, 392, 629	77, 039, 379	4. 9
13. Primary smelting and refining of nonferrous metals	956, 572, 486	1, 232, 353, 237	304, 883, 296	3, 694, 314, 367		4. 8
14. Cotton yarn	198, 940, 444	43, 419, 841	3, 478, 671	766, 128, 762	806, 069, 932	4. 1
15. Cotton broad woven goods	869, 354, 285	862, 412, 432	113, 422, 298	2, 651, 280, 915	3, 400, 271, 049	3. 9
16. Wood naval stores	14, 114, 193	47, 461, 068	6, 157, 839	11, 435, 552	52, 738, 781	3. 7
17. Steel castings	135, 466, 423	33, 032, 825	49, 764	450, 836, 485	483, 819, 546	3. 6
18. Custom slaughtering, wholesale	1, 932, 722	500, 000		5, 562, 695	6, 062, 695	3. 1
19. Blast furnace products—steel works and rolling mills	3, 270, 821, 877	5, 680, 080, 722	1, 349, 587, 089	5, 118, 980, 842	9, 449, 474, 475	2. 9
20. Gypsum products	46, 241, 980	18, 091, 184	119, 949	114, 938, 913	132, 101, 148	2. 9
21. Lime	36, 971, 171	9, 004, 875		97, 821, 648	106, 829, 523	2. 9
22. Processed waste and recovered wool fibers—contract factories	1, 449, 449			3, 927, 816	3, 927, 816	2. 7
23. Minerals and earths, ground or otherwise treated	38, 903, 146	4, 201, 977		98, 745, 502	102, 947, 479	2. 6
24. Corn sirup, corn sugar, corn oil, starch	119, 408, 253	284, 782, 920	6, 000	17, 386, 893	302, 163, 813	2. 5
25. Flat glass	102, 389, 012	88, 915, 677	12, 071, 800	177, 370, 757	254, 214, 634	2. 5
26. Jute goods (except felt)	16, 897, 414	26, 157, 000		14, 287, 002	40, 444, 002	2. 4
27. Rayon broad woven goods—contract factories	5, 306, 825	629, 340		11, 950, 326	12, 579, 666	2. 4
28. Salt	27, 530, 172	55, 792, 387	2, 250, 398	12, 006, 490	65, 548, 479	2. 1
29. Glass containers	158, 271, 647	42, 977, 311	22, 132	320, 268, 976	363, 224, 155	2. 3
30. Silk broad woven goods—contract factories	1, 101, 949			2, 583, 858	2, 583, 858	2. 3
31. Fuel briquets	5, 287, 282	1, 728, 900		9, 741, 515	11, 470, 415	2. 2
32. Hardwood distillation and charcoal manufacturing	6, 843, 172	11, 143, 805	95, 600	3, 844, 878	14, 893, 083	2. 2
33. Bone black, carbon black, and lampblack	14, 626, 876	2, 050, 830		29, 240, 306	31, 291, 136	2. 1
34. Brick and hollow structural tile	78, 153, 227	10, 334, 640	389, 085	154, 639, 118	164, 584, 673	2. 1
35. Woolen and worsted mfg.—contract factories	13, 156, 533	8, 801, 928	611, 020	19, 828, 406	28, 019, 314	2. 1
36. Cotton thread	51, 376, 151	32, 075, 356		68, 180, 555	100, 255, 911	2. 0

SOURCE: *Census of Manufactures, 1939.*

TABLE 15.—*Production, value of product, and electric energy consumption in selected electroprocess industries, 1935*

Industry	Production	Value of product	Electric energy consumed	Kilowatt-hours per dollar value of product
	Short tons	*Dollars*	*Kw.-hr.*	
Calcium carbide	147, 092	6, 234, 380	464, 000, 000	74. 5
Ferroalloys made in electric furnaces	216, 622	23, 476, 583	1, 220, 000, 000	51. 8
Aluminum	59, 648	22, 070, 000	1, 128, 967, 000	51. 2
Electrolytic zinc	121, 582	10, 456, 052	470, 465, 000	45. 0
Magnesium	2, 121	1, 272, 000	42, 412, 000	33. 4
Electrolytic caustic soda	287, 520	11, 263, 248	444, 000, 000	23. 1
Chlorine [1]	207, 380	7, 961, 186		

[1] Most chlorine is produced jointly with caustic soda in the electrolysis of brine.

SOURCE: Production data from *Minerals Yearbook: Census of Manufactures;* and Federal Power Commission, *Power Requirements in Electrochemical, Electrometallurgical, and Allied Industries,* table 3, p. 14. Value data from Bureau of Mines and *Census of Manufactures.* Energy consumption data from Federal Power Commission, *loc. cit.*

steel, superphosphate fertilizer manufacture, and various explosives and minor metals.[25]

The electroprocess industries as a whole constitute a rapidly expanding sector of the American economy. In the 12 years from 1925 to 1937 the production of aluminum increased 109 percent, of magnesium 1,760 percent, of electric furnace ferroalloys 163 percent, of crucible and electric steel 67 percent, of electrolytic zinc 48 percent, of calcium carbide 51 percent, of electrolytic caustic soda 194 percent, and of chlorine 445 percent.[26] This expansion, moreover, was all prior to the war, which is magnifying manyfold the demand for the light metals, high-grade steels and ferroalloys, and many electrochemical products. It is also worthy of note that where electrochemical processes compete directly with other processes as in caustic soda manufacture, or where electroprocess manufacture achieves a higher-grade (although somewhat more costly) product, as with special steels, ferroalloys, and zinc, the proportion of the total electrically produced has also shown a strong upward trend. Thus, in 1937, 46 percent of the total caustic soda production was made electrolytically rather than by the lime-soda process, as against only 32 percent in 1921. In the period 1923 to 1939, crucible and electric steel increased from 1.0 to 2.0 percent of total steel output, while the proportion of zinc electrolytically refined rose from 14 to 23 percent. This tendency is a product partly of technical development but also of the rapid lowering of industrial power rates, which fell on the average almost 30 per-

[25] The electrolytic refining of copper, while technically an electroprocess industry, is not economically one, since the consumption of energy per dollar value of product is only 1.6 kilowatt-hours.

[26] Computed from production data as reported by Bureau of Mines and *Census of Manufactures.*

TABLE 16.—*Distribution of intensive power consuming plants, by industry groups, 1940*

Kilowatt-hours consumed per dollar value of product	Total	Food	Tobacco	Textiles	Apparel	Lumber and timber	Furniture and finished lumber products	Paper	Printing and publishing	Chemicals	Products of petroleum and coal	Rubber	Leather	Stone, clay and glass	Iron and steel	Nonferrous metals	Electrical machinery	Machinery excluding electrical	Automobiles and automobile equipment	Transportation equipment excluding automobiles	Miscellaneous	Coal mining	Oil and natural gas	Ferrous mining	Extraction industries (nonferrous)	Nonmetallic minerals
64–72.9	3									1					1											1
56–63.9	10	3						1		3						2		1								
48–55.9	17	5					2			5					1	1										2
40–47.9	31	17		1			1			7							3									2
36–39.9	20	6		1				2		7					1		1						1			1
32–35.9	33	13						1		12				5	1											1
28–31.9	44	18						2		13				6		1	1									3
24–27.9	62	28		1		1		5		13	1			7		1		1					1		1	2
20–23.9	77	40				1		7		11				9	3						2				1	3
18–19.9	49	20		1			1	7		8				9	1								1			1
16–17.9	94	51		1			1	8		3				21	2	1	1					1			2	2
14–15.9	113	54	1				1	16		5		1		20	3	1		1			1	2	1		3	3
12–13.9	139	58		1		1		18		4				25	2	1					1	1	7		11	9
10–11.9	135	44	1	6				28		9	1	1		17	3	2						1	2		9	11
9–9.9	87	23		6	4	1	1	14		16	1			7	3	1						1	1		2	11
8–8.9	93	11		16		2		17		2	1	1		3	8	2					1	4	4		6	15
7–7.9	155	13		38	1	2		34		8		1		2	14	1		1	1		2	14	4	2	5	12
6–6.9	212	14		60		4	1	36		7	3	1		8	14			2	1		1	19	1		10	30
5–5.9	310	18	1	64	1	5	1	36		13	9	2		13	43	4	1		2	1	2	27	6	3	15	43
4–4.9	463	29	1	87		14	3	30		19	8	1	2	28	56	5	3	12	1	2	1	57	9	5	13	77
Total number of plants	2,147	465	4	284	6	31	12	262		160	24	8	2	180	156	26	7	18	5	3	11	138	38	10	78	229
Median	7.6	14.8	8.0	5.9	9.3	5.3	12.0	7.9		18.0	5.4	7.0	4.5	13.0	5.5	10.0	5.5	4.8	5.8	4.8	7.8	5.3	7.8	5.0	7.2	5.9

SOURCE: Federal Power Commission, *National Defense Power Survey, 1941;* special tabulation made for National Resources Planning Board, Industrial Location Section.

cent between 1926 and 1940. Thus normal trends, quite apart from the exigencies of war, foreshadow an enhanced position for these industries in the American scene.

Within the electroprocess group itself, there is considerable variation in the locational importance of low-cost power. While costs under 1 cent per kilowatt-hour are almost a *sine qua non* of profitability for such intensive power consumers, the search for extremely low power costs is sometimes tempered by the location of raw materials and less often by that of markets.

In the production of aluminum metal by electrolysis of fused alumina, cheap hydroelectric power has been by far the outstanding locational factor. Before the recent expansion in aluminum capacity, the five reduction plants of the Aluminum Company of America were located at Niagara Falls and Massena, N. Y.; Alcoa, Tenn.; Badin, N. C.; and Vancouver, Wash. Cheap water power is determining in suggesting new locations in the Pacific Northwest, the Tennessee Valley, and elsewhere. The great bulk of domestically produced artificial abrasives are manufactured at Niagara Falls. With magnesium, on the other hand, the sole plant until very recent years was at Midland, Mich., where raw materials were available at low cost as byproducts of other processes. In the location of new magnesium plants, cheap power stands about on an equal footing with availability of materials. Electrolytic zinc is produced for the most part in Montana and Idaho, where fairly low-cost water power is available close to the mines. The location of one electrolytic refinery at East St. Louis, however, shows the pull of raw material deposits in the Joplin area more than outweighing somewhat unfavorable power costs. A similar balance between the factors of electric energy and material supply has been struck in locating the calcium carbide and electrolytic caustic soda-chlorine industries. In the latter instance the important market of the paper industry has combined with cheap power in promoting recent locations in West Virginia, Washington, California, Texas, and Louisiana, in addition to the long-established producing center at Niagara Falls.

A more general picture of the location of intensive power-consuming plants is afforded through analysis of the Federal Power Commission's National Defense Power Survey, made early in 1941. The survey covered a total of 16,641 plants, with a total energy consumption in 1940 of 80,049,628,007 kilowatt-hours, or about 86 percent of the industrial total. Extractive as well as manufacturing industries were included. Of the plants surveyed, 11,646 reported, along with other information, the energy consumption per dollar value of product, which serves as a measure of intensity of power use.[27] A frequency distribution by industry groups of the 2,147 plants reporting over 4 kilowatt-hours per dollar value is presented in table 16. The large number of plants in the food group is accounted for by the widely distributed manufactured ice industry. With this exception, chemicals, paper, and stone, clay, and glass are far in the lead in the upper brackets.

In figure 76, the location of all plants consuming 10 or more kilowatt-hours per dollar value, and with more than 2,000,000 kilowatt-hours absolute consumption in

[27] A special tabulation of the data, arrayed in descending order of kilowatt-hour consumption per dollar value of product in 1940, was made by the Federal Power Commission staff for the purposes of this study. The analysis in this section of the text, together with table 16 and figure 75, is based on this tabulation.

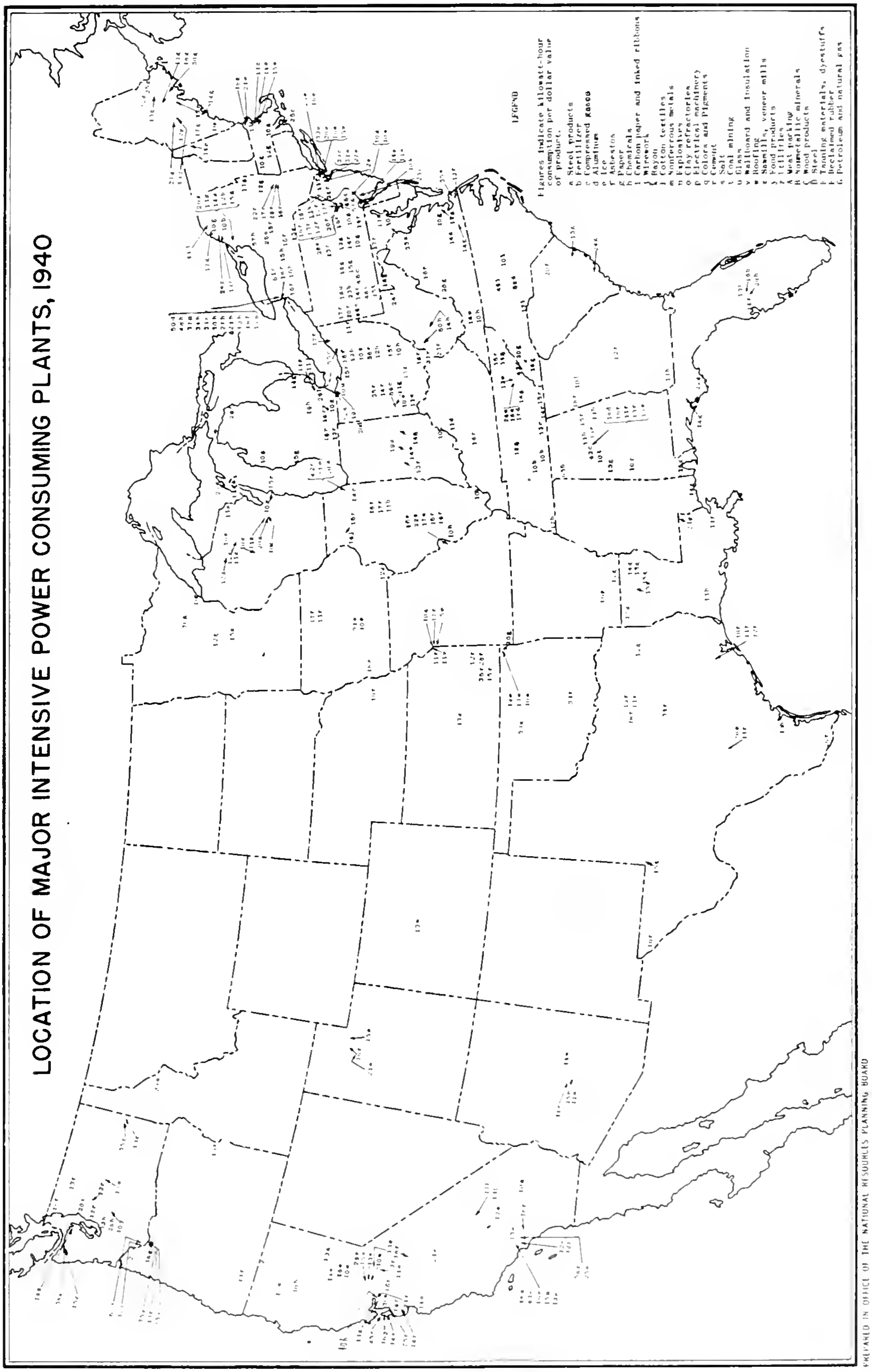
LOCATION OF MAJOR INTENSIVE POWER CONSUMING PLANTS, 1940
LEGEND
Figures indicate kilowatt-hour consumption per dollar value of product.
a Steel products
b Fertilizer
c Compressed gases
d Aluminum
e Ice
f Asbestos
g Paper
h Chemicals
i Carbon paper and inked ribbons
j Wirework
k Rayon
l Cotton textiles
m Nonferrous metals
n Explosives
o Clay refractories
p Electrical machinery
q Colors and Pigments
r Cement
s Salt
t Coal mining
u Glass
v Wallboard and insulation
w Roofing
x Sawmills, veneer mills
y Food products
z Utilities
A Meat packing
B Nonmetallic minerals
C Wood products
D Steel
E Tanning materials, dyestuffs
F Reclaimed rubber
G Petroleum and natural gas
PREPARED IN OFFICE OF THE NATIONAL RESOURCES PLANNING BOARD

FIGURE 76

1940, is mapped together with an indication of consumption intensity and industry. The map brings out in sharp relief a number of characteristic locational patterns. Concentration of plants in the low-cost water power regions—Niagara Falls, the Southern Appalachians from West Virginia to Northern Alabama, the Pacific Northwest, and California—demonstrates almost pure power orientation, with aluminum and other electroprocess industries predominant. At the other extreme are instances of pure market orientation (ice) and pure material orientation (the mining of geographically concentrated ores). The chemicals group as a whole shows close balance between considerations of power, fuels, materials, and markets. In paper and compressed gases, material availability dominates locational choice, but attention is also given to low-cost power. In cement, finally, the predominant factors are markets and materials, but location is also influenced to some extent by relative costs of power and fuels.

It is evident that low-cost power alone does not suffice to create an industrial area with any wide degree of diversification. The specifically power-oriented industries are few in number and limited in character. But where low-cost power and electroprocess raw materials occur in conjunction, the groundwork exists for industrialization on a substantial scale. This combination is the key to policy in industrial development around the public power projects of the Northwest and the Tennessee Valley.

In addition to its influence on interregional industrial location, electric power is potentially significant for the intraregional distribution of industry among metropolis, suburb, small city, and rural area. On a regional basis, power rates economically related to costs will undoubtedly always favor areas with natural advantages of water power and cheap fuel. But within very wide zones, power costs are strongly modified by such factors as the interconnection of steam and storage hydro plants into integrated systems, and the interconnection of diverse industrial, commercial, rural, and residential loads. Improvements in load factor and utilization of secondary power afford savings of an order of magnitude considerably greater than transmission costs narrowly interpreted. The geographical allocation of savings from large-scale interconnections is largely a matter of policy, and it may be by no means economically unjustifiable to charge uniform rates over an entire interconnected area. In so far as differential power costs influence locations, therefore, this circumstance places power in a strategic position for employment as an instrument of positive locational policy.

CHAPTER 8.—WATER

By Glenn E. McLaughlin*

Influence of Water Supply on Plant Location

The locational importance of water, as of most production requirements, depends on regional differences in the quantity and quality available to meet varying industrial needs. For some industries, water requirements are of great importance, and large areas of the country are unsatisfactory for the operations involved because of the inability to meet these needs, while the selection of a particular site within a favorable area often depends on ready access to water supplies. For many industries, of course, water requirements are of little significance.

The problem of providing an adequate, economic water supply varies widely with the prospective use. In some industries, water is needed mainly for cooling purposes, and the problem consists chiefly of providing large enough quantities. In others, where water is used primarily for washing or processing materials, the major concern is to obtain pure water. Where water is used as a raw material, the supply may have to be of a specified mineral content.

The use of water by one plant may be no bar to reuse by another plant on a downstream site. In other cases, however, the first mill may have altered the temperature, composition, or other qualities of the water to a degree that prohibits certain processes from occupying a nearby downstream site, unless water is treated between uses. Thus one type of industrial use of water may have a locational effect on other industries.

Some communities have considered water supply an important factor in attracting new plants and retaining old ones, and have developed water supply to this end. Such areas may grant preferential water rates to industry, and at least one city furnishes water free of charge.

Industrial Uses of Water

1. *Transportation.*—Where inland waterway navigation is an important asset, it may be necessary in time of low natural stream flow to maintain navigable depths by water released from reservoir storage, and by the assistance of properly spaced locks and dams. These releases may give other benefits, as in diluting stream pollution to within tolerable limits; but provision for them must usually be at the cost of other beneficial uses of the stored water. An example is the allocation of water stored in the Fort Peck Reservoir, Montana, to navigation on the Missouri River instead of to irrigation. Wherever the local expansion of industry is dependent on water transportation, conflicts may easily develop over alternative uses of water. (For a discussion of the importance of transportation as a factor in industrial location, see Chapter 9 of this report.)

2. *Water power.*—Industrial importance of the Pacific Northwest, the Tennessee Valley, the Southern Piedmont, and many other sections of the country, has stemmed largely from the availability of the cheap hydroelectric power. In these areas the water required for this purpose receives a high priority among alternative uses, although it is often possible to combine the use of water for power development with that for navigation improvement in the form of a multipurpose water project. (For a full discussion of the effect of cheap power in industrial development, see Chapter 7 of this report.)

3. *Raw materials.*—In some industries, water is an important raw material. Water can be broken down by electrolysis to produce hydrogen and oxygen; both are produced commercially in this manner. In the brewing and distilling industries, for example, water enters directly into the manufacture of the finished product and is one of the major location factors. When used for this purpose it must be free of organisms likely to produce abnormal fermentation. The requisite mineral content of the water depends on the type of beer to be brewed; thus, a hard gypseous water apparently is most satisfactory for the manufacture of light beer, whereas soft water is more appropriate for dark beers.[1] The type of beer produced in certain localities is related to the water supply: Munich, Pilsen, Monterrey, are examples.

Sea water is a source of supply of certain minerals—among them, magnesium and bromine.

4. *Boiler feed.*—For general manufacturing purposes it is desirable that water should be pure enough to avoid the rapid formation of boiler scale. Steam is of such general significance in manufacturing that if the water supply cannot be made satisfactory for the boiler feed except at very high costs, then the locality is clearly unfavorable for any sizeable industrial development.

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[1] If the saline characteristics of the water are not satisfactory, brewers sometimes add gypsum and other salts in order to produce the chemical action on the malt to give the desired body and taste. The presence of certain salts, mainly magnesium sulphate, is also important in promoting a healthy development of yeast.

For steam power plants the availability of satisfactory water for steam generation and condensing is likely to be a major consideration in choosing the exact location within a wide and generally favorable area. The demand for water is sometimes so great as to necessitate the construction of storage dams.

Process steam in large quantities is required in many other industries. For example, low pressure steam is used in the process of paper digesting and in textile finishing. In other industries, steam is used in the process to treat or heat the materials; for example, evaporating and cooking in the chemical, sugar, and food industries.

5. *Condenser water.*—In steam-electric plants and in industries using steam directly for power, large amounts of condensing water are necessary. For example, at the plant of the Corrigan-McKinney Steel Co. in Cleveland, water consumption for condensers in 1927 approximated 1.5 billion gallons per month.[2] Lack of adequate condensing water is the main reason why cheap power usually cannot be produced in the neighborhood of coal mines. In the newer power plants, condensers require about 800 tons of water per ton of coal consumed. Water for this purpose does not have to be pure, since it is usually applied externally in surface condensers to lower the temperature. Thus, water obtained either from surface or ground sources can be used usually without treatment. On the other hand, at some places river water is so acid that it eats the boiler and condenser tubes. Under such circumstances the water must be treated or tubes of noncorrosive metal installed.

6. *Water for other cooling uses.*—For the purposes of cooling machinery and materials, large quantities of chemically satisfactory water are necessary. In processes requiring temperature reduction, water is often the cheapest cooling medium. Water is thus extensively used in the making of iron and steel, in the refining of petroleum products, and also in the cooling of air and gas compressers and internal combustion engines. Steel plant operations require the handling of a great volume of water each day. Various parts of the furnace and of the rolling equipment are cooled continuously with water which needs to be of a normal temperature to be effective. For example, one handicap suffered by the steel industry at Youngstown is the inadequate supply of industrial water; during seasons of peak steel production or of drought, river water may reach very high temperatures because of repeated use.[3] Under such circumstances a much greater volume of water must be used and this in turn requires additional purifying and cooling equipment. A large integrated steel plant simply cannot operate satisfactorily except where there is an adequate supply of water. In the Pittsburgh district, a steel plant was reported to use 250 million gallons of water per day, largely for cooling, whereas a nearby city of 25,000 used only 1 million gallons per day.[4] Of course, most of the steel plant use was not consumptive.

Water is sometimes used to cool materials directly; for example, it is sprayed on byproduct coke when the heat is sufficiently advanced in order to arrest combustion. In many cooling processes, water circulates around the equipment; although air can be used, water is usually more satisfactory. Its importance in most internal combustion engines is such that if cooling were not provided, the heat would burn the lubricating oil, score the cylinders, and stick the pistons and valves. Water for cooling is also important in the compressing of air and ammonia, in operation of heavy machinery, and in metal processes which generate heat by turning, drilling, milling, and grinding. The increasing use of water for refrigeration processes, especially air conditioning, has overtaxed the ground water supply of some communities.

Wherever large amounts of water are required for cooling and where the supply is not adequate, it is necessary to resort to expensive artificial means of recirculating and lowering the temperature, by the use of large reservoirs, ponds with spraying devices, and cooling towers.

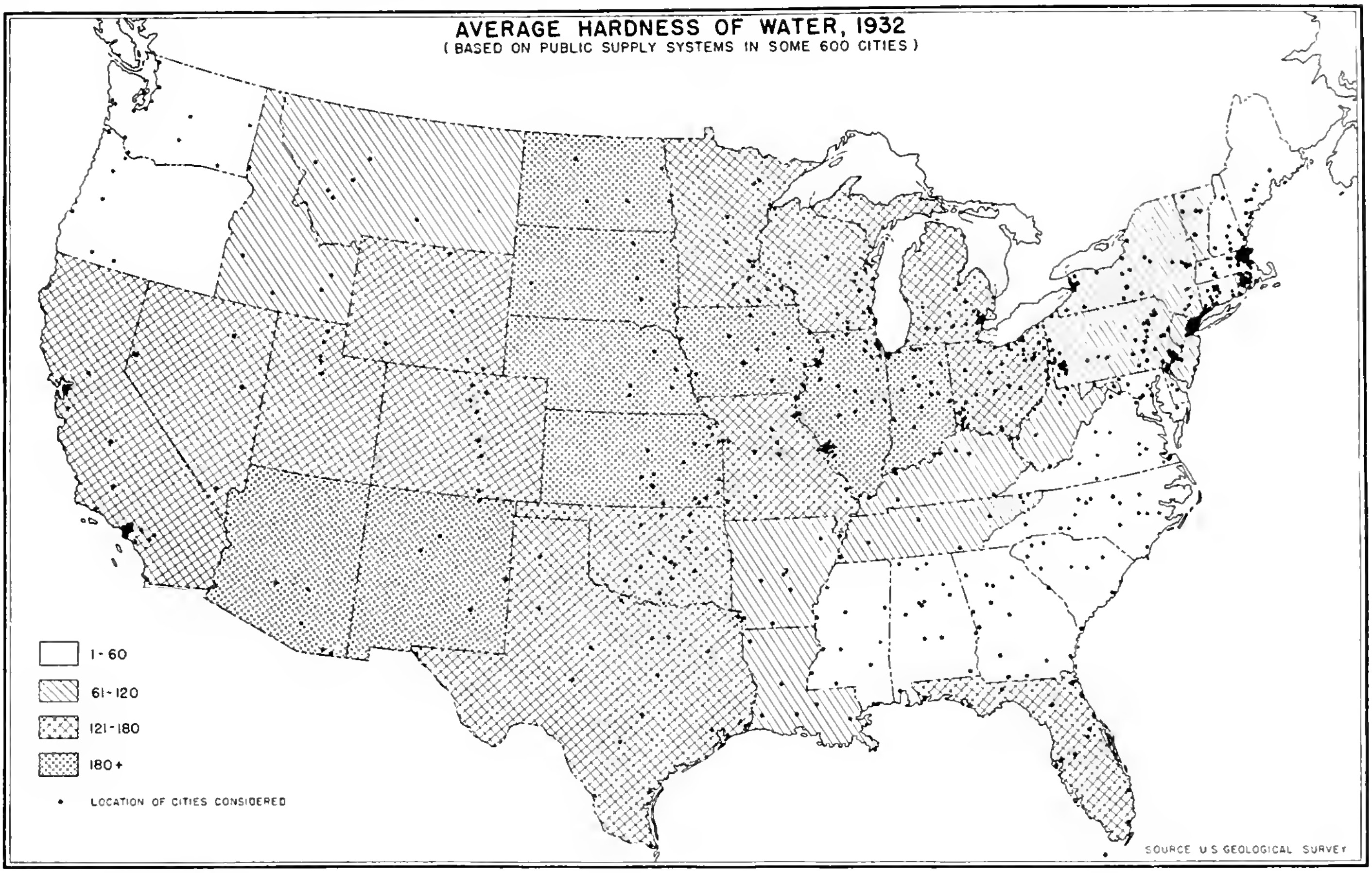
7. *Washing and cleaning.*—In concentrating ore and preparing it for smelting, water may be the most difficult requirement to meet, particularly in the arid regions of the West. In the process of ore washing or ore dressing, water is forced up-grade against crushed ore to separate the finer clay and sand particles. This process is used in both iron and nonferrous ores. Moreover, in placer mining the water supply is the major prerequisite. Water is required also for washing and cooling blast furnace gases so that they can be used either under boilers or in internal combustion engines. Water is required for cooling and washing artificial illuminating and fuel gas as well as byproducts, such as coke oven and blast furnace gas. Laundries, of course, are also important users of water.

[2] *Mechanical Engineering*, August, 1928, p. 623.

[3] The Ohio State University, *Engineering Experiment Station News*, October, 1941, pp. 9–10.

[4] *Mechanical Engineering*, August 1928, pp. 621–622. In 1927 the consumption of water by another mill in the Pittsburgh district was estimated at 32.3 billion gallons distributed as follows in billions of gallons: Electric power plant, 2.3; hydraulic power, 1.1; blowing-engine condensers, 3.4; byproduct coke ovens, 2.8; blast furnaces, 11.0; open-hearth furnaces, 4.1; blooming mill, 2.3; tube mills, 2.0; seamless tube mills, 2.0; miscellaneous, 1.3. *Ibid.*

A 600-ton blast furnace consumes approximately 17,000 tons of water per day. The products include 3,400 tons of gas, which is usually cleaned by water. See E. E. Thum, "Iron and Steel," *Encyclopedia Britannica*, 14th Ed., p. 653.



Units shown equal parts per million.

FIGURE 77

Where the supply is not abundant the large amounts of water used for these cleaning processes may be used again after passing it through cooling towers and settling basins.

8. *Process water.*—In some industries water enters directly into solutions or mixtures containing the materials being processed. In these instances abundant local supplies of pure water are indispensable to successful operation and a determining factor in plant location in these industries. Examples include sugar refining, bleaching and dyeing textiles, silk processing, and production of rayon, chemicals, paper, pulp, hides, and leather. In paper production, water is employed to suspend the cellulose fiber, which is beaten in the water to form a felted mat or tissue; in another stage of the process the materials are boiled in water and treated chemically while in suspension. In many industries, boiling in water is required in the washing and bleaching operations. In certain districts of Wisconsin the color of the natural water prevents the manufacture of bond paper.[5]

[5] F. E. Turneaure and H. L. Russell, *Public Water Supplies*, 1940, p. 185.

Water containing iron is particularly detrimental in textile dyeing and bleaching as well as in the productio of paper and pulp. The lack of adequate pure water has been a handicap in some localities to the expansion of plants producing rayon, cellophane, and textile products. The amount of hardness allowable in water for industrial use is limited in some operations, particularly in laundries and textile finishing, where hardness increases the amount of soap consumed or otherwise complicates the process.

In sugar processing, water of a good quality is required for spraying the crushed cane or beets in order to secure the maximum yield of sucrose and in another part of the process the raw sugar is dissolved in water as a preparation for further refining. In some areas the production of glucose sugar from corn products has been impracticable because the sulfur in the local water renders the product cloudy.

9. *Carriers of industrial wastes.*—In many industries the volume of industrial wastes is a problem in plant location. It has been estimated that the total capital cost of construction for industrial waste treatment is between $800,000,000 and $900,000,000 plus an

annual operating cost of 20 to 25 percent of the initial investment.[6]

If the cost of installing a waste treatment process is much in excess of that of the materials recovered, an industry will naturally seek a site on a stream into which it is allowed to discharge waste materials. Occasionally a site for such a plant can be found near the confluence of a clean stream providing process water and another one carrying wastes. The problem of disposing of waste materials is perhaps greatest in paper mills, chemical plants and dye works, bleacheries, soap factories, and steel mills. Even these industries, however, have developed means for recovering wastes so that provision of waste disposal is not always of locational significance. On the other hand, waste disposal from manufacturing plants may require location on a large stream. Furthermore, disposal of wastes may contaminate the water for a great distance downstream and thus influence plant location. The Arkansas River in central Arkansas, for example, has a high content of dissolved chlorides resulting in part from oil-well pollution in Oklahoma and Kansas.

Industrial waste materials have been divided into three classifications: (1) organic, (2) toxic, (3) inert.[7] Industries with waste products of the organic type include: milk products plants; beet sugar factories; tanneries; canning factories; meat packing plants; breweries and distilleries; paper and strawboard mills; laundries; textiles and dye works. In most areas, regulations require the installation of waste treatment plants to remove or neutralize wastes of this type. Wastes of the toxic variety occur in metal plating, metal manufacturing plants, gas plants, chemical plants, coal and other mines. In some states recovery or treatment regulations have also applied to this category of wastes. Inert wastes which are important in the consideration of pollution problems are produced in hydraulic and drift mining, saw mills, gravel pits and in the refining of some metals.

10. *Fire protection.*—Some types of operations require the storage of large amounts of water for fire protection. Wherever the process deals with inflammable materials, plant location is likely to give considerable emphasis to water supply.

11. *Domestic and commercial use and sewage disposal.*—If industrial development occurs in an area where there has been little previous urban development, it will necessitate the establishment of a new community. Even in an older city, the introduction of a larger plant may lead to expensive enlargements of local water and other utility systems. Water consumption in industrial operations probably averages between 10 and 50 gallons per capita per day in large cities, whereas domestic requirements for drinking, cooking, washing, and general home use average between 20 and 60 gallons per capita per day, and commercial use from 5 to 10 gallons per capita per day.[8] A larger city is more likely to have a water supply adequate for a considerable addition to population than is a smaller city. In a smaller community a new producer might have to consider water for domestic and commercial as well as industrial use.

12. *Agriculture.*—In arid parts of the West the reservation of major portions of available water for agricultural and domestic use may leave an inadequate supply for industrial development. In metropolitan areas of the Rocky Mountain region, for example, the demands of nearby agricultural areas for water are likely to take a large portion of the available supply and thus to restrict the expansion of industrial production.

Supply and Quality of Water

Water can be obtained from either surface or ground sources. Usually it is cheaper to tap surface sources, yet in some places the construction of upstream storage dams may be needed to regulate the flow to industrial plants. Moreover, in some districts and for some processes, surface water has to be treated for contamination and discoloration. In many areas, ground water is the more dependable source; in some places it is the only adequate source. Its provision, however, raises problems. Since ground water moves very slowly, it often contains a higher proportion of dissolved minerals, which makes it unsuitable without treatment for cooking, laundering, and some industrial purposes. The higher proportion of carbonic acid sometimes found in ground water is undesirable because it causes corrosion of metal equipment. Often these dissolved minerals must be removed by aeration and sedimentation or by treatment with chemicals. The primary advantages of ground water are lower temperature, at least during the summer, and lack of silt. In general, however, ground waters are less desirable than surface water because of their high mineral content.

In any event, the characteristics of flow, the types and proportions of impurities in the water, and the volume available will determine whether an industrial plant will find it possible to use the local water supply. In arranging for its water supply, a prospective indus-

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[6] This estimate is based on the volume of production indicated in the 1935 Census of Manufactures. For further information see National Resources Committee, *Water Pollution in the United States*, 1939, pp. 52–59.

[7] *Chemical Industries*, August 1941, pp. 170–176.

[8] Turneaure and Russell, *op. cit.*, p. 16.

try must make allowances for the correlative rights of others which could, under present conditions of public law and administration, impair the quality or quantity of the water supply. For example, (*a*) continued excessive drafts on ground water have in many areas caused water shortages for long-established industries, and in some coastal areas have drawn in salt water which made the water unsuitable for many uses; and (*b*) the legally permitted increase of upstream waste discharge has in many areas impaired the quality of the process water which originally caused the selection of downstream plant sites. In some States, regulatory agencies are beginning to zone streams with respect to the amount of pollution permitted. The future industrial development of a river valley then will be influenced not only by present uses and exercise of upstream and downstream rights, but also by those which may yet develop.

In general, the western part of the country is short of water. Industries requiring considerable volumes of water can be located in only a relatively few districts in the region. It was possible for an integrated iron and steel plant to develop at Pueblo, Colo., for example, but water supply may set a definite limit on expansion at that point. Where water is scarce, it can often be reused, although additions must continually be made to the circulating supply. Although careful use of water increases somewhat the potential local expansion of industry, it does not remove the restrictive influence of a limited local water supply.

Water may become relatively scarce also in eastern districts as a result of the local growth of population and industry. Industrial and commercial use of water may increase much more rapidly than domestic use. Thus, the introduction of air conditioning in a few large office buildings and hotels or the operations of a new paper mill may absorb all available local water surplus and preclude further local industrial growth until other supplies are tapped. At times, relief can be obtained by connection with nearby water systems.

Some cities have had to go to distant sources to obtain supplies of water adequate for expanding local needs. Los Angeles, San Francisco, New York City, Boston, and Tulsa are examples.[9]

Alternative Uses of Water

Whenever total water supplies are insufficient to supply all desired uses, some selection must be made among the various alternatives. Even where supplies are abundant this question may be of great importance in planning a community's industrial and social future. No definite order of importance can be laid down which is applicable to all circumstances. Nonconsumptive and nonpolluting uses, such as hydroelectric generation, recreation, and transportation, are unlikely to interfere with other uses. Consumptive uses—domestic, agricultural, commercial, and industrial—may be directly competitive, and in most arid regions the domestic and agricultural uses will be given priority. Where extensive use is required for mining operations, on the other hand, as in many western communities, water may be reserved primarily for this purpose and for domestic requirements. Consumptive uses upstream may also interfere with transportation or power generation below. Nonconsumptive but polluting uses, moreover, may make water unfit not only for domestic purposes but also as a habitat for fish. Under these circumstances, it is evident that industrial location policy must have regard for alternative water uses and that optimum water use implies effective planning for integration of industrial with other needs.

[9] For resulting water rates, see Tennessee Valley Authority, *Industrial Water Resources of the Tennessee Valley*, March, 1939, pp. 43–46.

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CHAPTER 9. TRANSPORTATION

By Edward S. Lynch*

Introduction

The peculiar importance of transportation to the location of economic activities arises out of the fact that location is a matter of spatial consideration and transportation costs are the price for overcoming distance. It is generally agreed that transportation exerts a very significant influence on location. Most students of the subject have been wont to consider it the most important single factor. Some, like Alfred Weber, seem to have considered it more important than all other factors combined.[1]

Claims that particular regions are favored and others unjustly prejudiced by the relationships obtaining between transportation rates are perennial. The controversy that has raged for several years over the railroad rates on manufactured products from the southeastern part of the country to the Northeast is an example. The slow economic development of the Intermountain States and the relatively rapid development of States on the Pacific Coast have been attributed to a rate structure that favored the latter as against the former. Another type of rate structure, it is alleged, would foster the economic development of the South and of the Intermountain States. It has frequently been charged that discriminatory transportation rates have fostered the growth of large urban centers and that appropriate revision of the rate structure would result in a decrease in their size.

It is the object of this section to indicate the influence of transportation on the geographical location of economic activity, other things being equal. For such matters as differences in labor costs at various places, economies of large-scale production, industrial pricing policies, and a host of others, discussed elsewhere in this report, combine with transportation service and its cost to achieve the locational pattern of economic activities.

Influence of Transportation on the Exploitation of Natural Resources

The location of mining, forestry, and agricultural activities is bound, of necessity, to the natural resources concerned. Which of several sources of raw materials is utilized and the extent to which it is utilized depends upon several factors, among them the costs of transportation from the various sources to market.

Variations in the relative prosperity of mining regions have frequently resulted from changes in the relationships existing among transportation rates charged various sources. Development of the Southern Appalachian coal fields were long delayed because of distance from and resulting high transportation costs to major consuming markets. Exhaustion of timber stands in West Virginia impelled railroads serving that area to offer to transport coal to markets in the North at low rates. This action contributed to an expansion in coal-mining operations in southern West Virginia largely at the expense of Pennsylvania and Ohio. The development of the motor truck, which caused a change in the relationship between rates on long and on short hauls in favor of the latter, has also brought about significant shifts in the location of coal production. In the late twenties, the area within 25 or 30 miles of St. Louis, known as the Belleville field, became studded with small coal-mine operations, which had theretofore been effectively discouraged by a railroad freight rate structure that favored shippers of higher-grade coals beyond 100 miles to the east of St. Louis. In 1938, the major portion of St. Louis' coal supply came from the Standard Belleville field, most of it by truck.[2]

Variations in the prosperity of agricultural areas as a result of changes in transportation rates and services are well known. Perishable fruits and vegetables and packing-house products are now hauled many hundreds of miles, whereas 70 years ago they could be hauled only a relatively short distance. Relative transportation charges on potatoes have been important influences in the competitive struggles of producers in Maine, Idaho, Michigan, and New York with one another. The increase in freight rates after the first World War is said to have redounded to the advantage of New York producers located near major consuming markets and to the disadvantage of growers in Idaho and Michigan.[3] Relative charges for transporting feeds and livestock have dictated the degree of special-

*Consultant, National Resources Planning Board.

[1] *Theory of the Location of Industry*, University of Chicago Press, 1929.

[2] Rail shipments of coal into St. Louis have increased greatly since April 1940, when an antismoke ordinance practically forced domestic consumers to use a better grade of coal. At the same time, the railroads put in a train-load rate of $2 per ton, against a previous carload rate of $3.05 per ton, from Arkansas mines.

[3] Cf. H. S. Gabriel, *Index Numbers of Freight Rates and Their Relation to Agricultural Prices and Production*, Bulletin No. 446, Cornell University Agricultural Experiment Station, 1925, pp. 31–34.

ization by various regions of the country in the production of one or the other. The competition in eastern markets of orange growers in California with those in Florida would have been much less intense if railroads serving the former producers had not "blanketed" the entire eastern part of the country for rate-making purposes. Until recently, transportation charges on oranges from California were the same to New York City as to Denver, Colo.

These scattered instances give some indication of the importance of transport factors in influencing the location of activities which might seem to be governed exclusively by natural conditions.

Influence of Transportation on the Location of Manufacturing

Much greater freedom of choice exists for the location of manufacturing plants than of raw-material production. But the location of the latter exercises a profound influence upon the geographical distribution of manufacturing. Unless significant economies of production scale exist or unless particular areas and sites are especially favored by relatively low production costs for other reasons—the availability of a low wage or of a highly skilled labor force, for example—particular manufacturing processes will be located with primary reference to the sources of their materials and to the markets for their products.

The question, will processing occur near the source of raw materials or near the market for the finished product, is relatively easy to answer where but one material is used, only one commodity produced, and transportation costs are reflected directly in prices.[4] The location of production will then depend on the relative costs of transporting materials in their unprocessed and processed states. Fabrication will occur near the source of the material if it costs less to transport the product than the material and near the market if the contrary situation exists.

The attraction of the raw-material source will be greater, the greater the weight loss in fabrication.[5] It is not surprising, therefore, that copper and lead smelters and refineries, wood-distillation plants, planing mills, cotton gins, and beet-sugar refineries are usually located very near to the materials which they employ. Transportation rates on the finished products could, of course, be made sufficiently high, and on the raw materials involved sufficiently low, to offset the influence of weight loss in manufacture upon location and thus to make location near the market more profitable.

However many materials enter a product, however many products are produced jointly from the same materials, the same principles apply. To the extent that one material or one product involves greater cost of movement than others, its source or market will have a correspondingly greater influence upon location. Service differences and differences in capital requirements influenced by transportation enter as qualifying factors.

Service

Costs of movement include more than the hauling charges of transportation agencies and shippers' expenses in operating their own vehicles. The quality of the service rendered is an important element in the total transportation cost to producers.[6]

Speed is one of the most important qualitative aspects of transportation; in its widest sense, it includes not only the actual time in transit, but also the frequency and dependability of carrier schedules and the degree of correlation of transportation with the production schedules of producers.

Goods in transit frequently represent a considerable absorption of working capital, the interest on which is one of the costs of transportation. It is, in fact, customary for zinc and for electrolytic copper to be sold at delivered prices which include interest on the value of the product while it is in transit.[7] Increased over-all speed of transportation also reduces storage requirements; and as a result interest on the value of the goods stored, expenditures for warehouse space, and the risks of price declines on inventory are reduced.

Since the interest cost on goods in transit and in storage is sometimes substantial, there is some incentive to locate manufacturing processes in proximity to their markets, for the value of fabricated products is generally greater than that of the materials of which they are made. One of the reasons suggested for the rise of Buffalo as a flour-milling center after the first World War was the saving in transit time on flour destined to eastern markets that was thus achieved. In earlier years the 3 to 5 weeks in transit on the Great Lakes contributed to the requisite aging of the flour, but general adoption of the bleaching process gave financial significance to time in transit.[8] The influence of the market on the location of manufacturing is reduced if over-all speed on fabricated products is greater than on materials, as is frequently the case.

[4] Cf. below, pp. 190–192.

[5] Cf. ch. 6 of this report, *"Materials."*

[6] Dr. Julius Parmelee writes: "It is impossible to estimate the exact savings improved rail efficiency has stimulated. It has been estimated, however, that manufacturers, shippers, and dealers, generally, have reduced their working capital by one-fourth. This reduction alone means millions of dollars of annual savings to them." (*The Modern Railway*, Longmans, Green & Co., New York, 1910, p. 237.)

[7] Cf. Saul Nelson, *Price Behavior and Business Policy*, Temporary National Economic Committee, Monograph No. 1, 1940, p. 339.

[8] Cf. Victor G. Pickett and Roland S. Vaile, *The Decline of Northwestern Flour-Milling*, University of Minnesota Press, 1933, p. 47.

Most commodities are subject to some form of spoilage or breakage. For some, refrigeration is required, if they are to traverse great distances; for others, heating is essential; for still others, ventilation is a necessity. Damage in transit can be reduced if specially equipped vehicles are employed.

These special services are available on all rail and many motor routes, but they are costly and the extra costs are reflected in the transportation rates charged. The processing of perishable materials, therefore, occurs typically near their sources; the canning of dried fruits and vegetables and the manufacture of certain dairy products are examples. Where the final product is perishable, bread for example, manufacture tends to be geographically distributed according to the consuming population.

Rates

Carriers typically charge rates that rise with the progress of fabrication from raw materials to final products; in some cases this has been done at the instance of the Interstate Commerce Commission. The result is a tendency for manufacturing to be located away from the source of raw materials and close to market, unless the weight loss in fabrication is sufficiently great to offset the difference in rates, or unless the service rendered manufactures is so much superior to that afforded materials as to offset the tendency.

In part this rate-making practice rests on the fact that competition in rates among carriers is limited, whereas products that are more valuable per unit of weight can generally bear higher transportation charges and still move. The so-called value-of-service principle of rate making used by railroads and adopted to some extent by motor carriers would be impracticable were it not for monopolistic elements.

The relationship between rates on materials and manufactured goods is partially based on differences in hauling costs. Transportation of crude oil by pipe line, for example, is cheaper than by tank car or motor truck. Hence refineries have been located near markets or at tidewater, where cargo tankers are available to carry the refined products to market at relatively low charges. "In 1920, about 51 percent of the refinery capacity of the United States was located inland and near oil-producing areas, but in January, 1931, 67.39 was located in coastal areas and near market centers, and only 32.7 percent inland near the oil-producing centers." [9] In general, manufactured goods load less heavily than materials, are more liable to loss and damage, and receive more expedited service and other service advantages; they are, therefore, more costly to transport.

Although the practice of charging rates that progress with the stage of fabrication is general, it is by no means universal. Where higher rates are imposed upon materials in the raw than in the finished stage, location of manufacturing plants tends to be near the source of materials rather than the consuming markets. An interesting example is the policy of railroads with respect to rates on hogs and packing-house products. On shipments east, hogs carry much heavier rates than do products obtained from processing them, and the weight loss in processing is about 25 or 30 percent. The result of this, along with other factors, has been the development of the packing industry in the Western Corn Belt.[10] This trend was furthered by the development of motor-truck operations in the twenties, which resulted in relatively low rates on hogs for short hauls.[11]

The practice of carriers of increasing their charges with distance,[12] but at a diminishing rate as distance increases, causes total transportation charges to be lower if manufacture occurs at the material source or at the market than anywhere else, since the sum of two short-haul charges is greater than a single long-haul charge. Unless, then, processing costs are sufficiently lower at some other place to offset its disadvantage in transportation costs, fabrication will tend to occur either at the source of the material or the market, the assumption made in preceding pages. Railroads, however, frequently grant fabrication-in-transit privileges, permitting a raw material to be stopped for fabrication at some place intermediate between its source and ultimate market, and the product then carried to market for substantially the same total charges as if the haul had not been interrupted. The in-transit privilege has been of great importance in the establishment of flour mills and other processing plants in places where they could not otherwise be profitably operated.

Economies of Scale and Differential Production Costs

The extent to which potential economies of large-scale production are exploited depends upon the level of transportation charges and on the service rendered by carriers. Concentration of production in one plant or at a single raw-material source in order to achieve

[9] G. Lloyd Wilson, James M. Herring, and Roland B. Eustler, *Public Utilities Industries*, New York, 1940, pp. 250–252. Development of the gasoline pipe line during the past dozen years has checked somewhat the tendency of refineries to locate away from oil-producing areas.

[10] Cf. *Direct Marketing of Hogs*, U. S. Department of Agriculture, Misc. Pub. No. 222, 1933, pp. 6–7 and 77–87 and *passim*.

[11] Transportation rates on hogs shipped westward are relatively very low in comparison to rates on meat products; packing plants have accordingly been located on the Pacific Coast in order to supply that market for meat.

[12] As noted later, there are numerous exceptions to this principle.

economies of large-scale production tends to be greater the lower the transportation charges on the materials used and on the product to the various markets served. The level of transportation charges could be increased sufficiently and the service rendered sufficiently deteriorated to make production on a large scale unprofitable.

Similar considerations obtain where a particular site affords opportunity for production at especially low costs, because of an especially favorable labor situation, for example. As already indicated, penetration of northern markets by Southern Appalachian coal producers was long retarded by high transportation costs, despite low labor and other production costs in the region. The home market can be preserved to high production cost sites by a relatively high level of transportation charges and relatively inferior service from other producing areas.

Changes in the levels of transportation rates, unaccompanied by changes in the relationships obtaining among individual rates, influence location by increasing the magnitude of absolute differences between specific rates. The trend of the packing industry to the Western Corn Belt discussed above was furthered by the increase in the spread between the charges for hauling hogs and meat products that resulted from the general percentage increases in freight rates during and after World War I. Equal percentage increases in transportation rates also increase the spread between long-haul and short-haul charges, thus reducing production-cost advantages held by shippers located more distant freightwise from their markets, while equal percentage reductions have just the opposite effect. In general, then, increases in the levels of transportation charges tend to greater decentralization and reductions in those levels to localization of production.

If prices in general change, while the level of transportation rates remains the same, the effect on location is the same. With falling prices, transportation becomes more expensive compared to other productive factors, and decentralization of industry is fostered. Some of the decentralization of industry that typically occurs in periods of depression may be attributed to the maintenance of freight rates at high levels while prices generally are falling. On the other hand, if prices in general rise and transportation rates remain unchanged or fall, the effect is to increase the concentration of industry and the magnitude of trade between areas.

Although decentralization of production can be achieved by making rates so high and service so bad as to discourage the use of transportation facilities, a thoroughly economical transportation system might effect decentralization of another sort. The separation of production into numerous stages from raw materials to final products, with each stage carried on where peculiar labor and other cost advantages dictate, is discouraged by high transportation costs, and would be stimulated if service were further improved and rates reduced.

Immobility of Production Resources and Industrial Location

Because of relative immobility of resources, changes in freight rates may not have so great an immediate effect on the location of economic activities as they otherwise would have. Moreover, it is very likely that even their long-run influence will be modified. Indeed, a change in freight rates to and from a particular locality will have substantially the same effects on the producers located there as would the imposition or removal of a sales tax of equal amount. All the difficulties encountered by students of public finance in attempting to determine the incidence and effects of a sales tax are encountered here.

An increase in freight rates on shipment of a product to market or on assembly of the raw materials used—the first involving a reduction in net realized price and the second an increase in production costs—will not usually result in complete shut-down by a firm operating with a large investment in relatively durable and specialized plant and equipment. Unless the cost increase or price reduction is so great as to render its investment valueless, it can be absorbed and production continued, though probably on a reduced scale, until need for replacement of plant and equipment arises. Indeed, durable and specialized plant and facilities may be regarded in the same light as a raw material resource subject to depletion—the material, itself, being almost completely weight-losing as a result of depreciation and obsolescence.

A reduction in freight charged to a competitor located elsewhere, which leads him to lower his price, will not usually enable him completely and immediately to absorb the market for the goods. The failure of an even more rapid advance in the packing industry to occur in the Western Corn Belt Area, in view of freight rate, wage, and other advantages is attributed to the very large and relatively durable investments that had already been made in Chicago and eastern cities.[13]

Because labor and capital are not completely mobile and because land and other natural resources are fixed in their locations, a rise in transportation costs bearing immediately upon a particular producer may be neither borne in its entirety by him nor passed along entirely in the form of higher prices to his customers. It may, for example, be absorbed by sellers of supplies

[13] Cf. U. S. Department of Agriculture, *op. cit.*, p. 9.

to him, themselves in a position to absorb the loss of net income involved, without changing their location and their production policies. The benefits of a reduction in freight rates may also be distributed among several factors. Owners of land, especially, are likely to benefit by reductions in freight charges and to suffer from increases in them.

Where labor tempers its demands for wages with a view to the competitive position of the employer, a change in transportation charges to the disadvantage of that employer may be partially absorbed by his labor force. This is not unlikely to occur even when labor is organized; witness the regional differentials that persist in wage agreements even between national unions and employers. It is very likely to occur when labor is unorganized. The major reason for this is the fact that the geographic mobility of labor is restricted because of expenses of movement, including partial loss of investments made in the locality concerned, and because of natural psychological resistance to movement. Labor, in other words, together with all other relatively immobile productive factors, including transportation facilities, participates in the competition of the combined resources of one region and those of another for common markets. Similarly, labor may reap the benefits of an improvement in the transportation situation.

As of any given time intimate relationships will have been established among producers in a particular region and at a particular site. Producers base their decisions with respect to location, among other things, on the locations of those firms from whom they purchase materials, and on the locations of those to whom they sell. Because reinvestment in various lines of activity tends to be made at different periods of time and very largely with a view to the existing locational structure of suppliers and of markets, the process of relocation as a result of a change in freight rates is very slow and likely never to be completely achieved.

Geographic Pricing Policies and Transportation [14]

Pricing policies in the nontransportation area of the economy frequently offset the influence of changes in freight rates on location. They may completely neutralize that influence or simply make it different from what the preceding analysis indicates.

Where competition in price is deliberately avoided, it is entirely probable that a reduction in the costs of a producer who does not "make the price"—who simply "meets competition"—will not result in a lowering of his price, and that increased costs will not impel him to raise his price. Moreover, a reduction in his costs will not necessarily result in an extension of his market, nor an increase in his costs in withdrawal from part of his market. Changes in freight rates from a mill or mine that does not "make the price" will not, therefore, affect the delivered price to the market concerned and so will have no effect on the location of firms purchasing its product. They may also have no effect on the location of the industry producing the goods concerned. The Federal Trade Commission, for example, found in the case of cement that "the mill whose base price and freight rate made the Chicago delivered price in 1927 is located near Chicago. The mill's output for that year was more than 9 million barrels, while Chicago's consumption was about 3,800,000 barrels. Less than one-third of this consumption was supplied by this mill, which at the same time shipped large quantities long distances on which it realized a mill net far below that realized on its Chicago shipments." [15]

An increase in transportation rates from a basing-point mill to a market which remains within its price territory will result in an increase in price to that territory. But it will not necessarily cause a reduction of the basing-point mill's share of the sales made there nor an increase in the shares obtained by mills from which no increase in freight rates has been made.

Purchasers of steel are sometimes prevented by the form of the pricing policy pursued in the industry from taking advantage of reduced rates by motor truck or by water carrier. On one occasion at least, a steel consumer was alleged to have been refused, in effect, the privilege of shipping steel pipe in its own barges when several steel companies would not sell the pipe delivered at the consumer's dock.[16] Other similar cases have doubtless arisen at one time or another. Purchasers of steel with plants on waterways may not therefore be able to take full advantage of their locations. It is sometimes the custom to add to the base price for steel 65 percent of the railroad freight rate to destination when purchasers haul steel away in their own trucks.

Attempts have been made by the cement and other industries to establish similar policies, discouraging the use of truck and water transportation. This prac-

[14] Cf. Chapter 18 of this report, "*Price Policies*."

[15] *Report of the Federal Trade Commission on Price Bases Inquiry*, 1932, p. XIX.

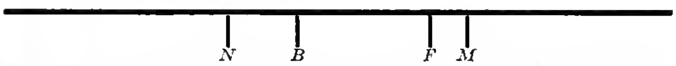
[16] Cf. letter to Mr. Chester R. Roberts, general sales manager of the South Chester Tube Co., from Mr. Gibson, his assistant, Temporary National Economic Committee Hearings No. 20, p. 10836; also, Saul Nelson, *op. cit.*, pp. 306–307

tice has also been established with legislative sanction in the bituminous coal industry.[17]

The fabrication-in-transit privilege sometimes operates to distort systems of "administered" prices. If producers of raw or semimanufactured materials are accustomed to meeting the prices of their competitors, regardless of the formal basis of price-fixing, a fabricator who is accustomed to using a fabrication-in-transit privilege sometimes finds it more advantageous to purchase from a mill which does not "make" the delivered price than from one which does.[18] The result in many cases is, therefore, to encourage greater concentration of fabrication owing to use of the fabrication-in-transit privilege and to encourage greater sales by a freightwise more distant producer, and incidentally to increase the amount of cross-hauling of freight. According to Professor de Chazeau, "almost 9 months before the code [steel code, under the N. R. A.] was formulated, a system of quoting delivered prices through transit points had been put into practice in an attempt to correct 'abuses' in the cross-hauling of steel."[19] The purpose, obviously, was to eliminate the peculiar price advantage accruing to fabricators enjoying the fabrication-in-transit privilege. In effect, an attempt was made to preserve to fabricators the advantages of the fabrication-in-transit privilege although eliminating the advantage arising out of its combination with the delivered price from a freightwise distant seller. Professor de Chazeau adds that the new system was apparently not "effectively enforced."[20] Nor were the attempts made under the steel code to enforce a like provision successful.

[17] Under the Bituminous Coal Act of 1937.

[18] A hypothetical example will serve to bring out the main details:



N, *B*, *F*, and *M* are, respectively, a nonbasing point, a basing point, the location of a fabricator, and the market for the latter's product.

The through freight charge from *B* to *M* is \$10 and from *N* to *M*, \$15, whereas the local freight charge from *B* to *F* is \$5 and from *N* to *F*, \$12.

In effect, the fabricator collects from the selling mill the rail charge from the latter to the point of fabrication. The total cost to the fabricator of the material as finally laid down at *M* is the delivered price at *F*, less the freight charge from the selling mill to *F*, plus the through freight rate from the selling mill to *M*, plus the charge made by the railroad for the fabrication-in-transit privilege.

The base price at *B* is \$20, and the delivered price at *F* is \$25, whether purchase is made from *B* or *N*.

If purchase is made from *B*, the total cost to the fabricator is, then, \$30 (\$25, minus \$5, plus \$10) plus fabrication-in-transit.

If purchase is made from *N*, the total cost to the fabricator is \$28 (\$25, minus \$12, plus \$15) plus fabrication-in-transit.

Fabricators at *F* obviously find it advantageous to purchase from *N* rather than from *B*, unless the service advantage of buying from the latter is worth more than \$2. They also have a transportation advantage over fabricators located at *B* or *M*, unless the charge for the fabrication-in-transit privilege is more than \$2.

[19] C. R. Daugherty, M. G. de Chazeau, and S. S. Stratton, *The Economics of the Iron and Steel Industry*, McGraw-Hill, New York, 1937, p. 472, footnote 2.

[20] *Loc. cit.*

While it is true that in some instances changes in freight rates may not give rise either immediately or in the long run to locational shifts, it is also indubitable that in other cases changes in freight rates are the occasion for shifts in the location of buyers or sellers, or both, even when prices of the goods concerned do not vary precisely with transportation costs. Freight rates from a mill to a particular market may be increased by a sufficient amount to induce that mill to withdraw from the market, unless it "makes the price" there. In numerous cases, producers set limits to the amount of freight that they will absorb in their delivered price.[21] Where this practice exists, an increase in freight rates to a particular market, which causes the delivered price thus calculated to exceed the prevailing price there, will impel the producer concerned to withdraw; unless, of course, his product is differentiated from those of competitors, in which case there is no "prevailing price," and the result will probably be simply some, though not necessarily complete, loss of sales.

Changes in the geographical distribution of many industries in which noncompetitive pricing policies are pursued are known to all students of the matter. While changes in transportation rates do not always result in changes in the price structure of an industry, they do change the profitability of operations at existing locations and, if sufficiently large, will cause some shift in location. Such shifts may result from integration policies of buyers of the product, who seek thereby to escape from the burden of paying monopolistic prices.

The fact that changes in transportation rates to various markets are frequently offset in the delivered prices charged by producers suggests the possibility that improvements in the service rendered by carriers sometimes have a greater influence on the location of economic activities than reductions in transportation rates. If competition among producers is primarily service competition, improvements in the transportation service rendered to them are probably more effective in extending their markets than reductions in rates equivalent to the added expense involved in affording the improved service.

Very close analogies can be drawn between the pricing policies pursued in industry and described elsewhere in this report[22] and rate policies established by carriers. The "systematic freight equalization," practiced in the salt and other industries, is not unlike the establishment by railroads and other carriers of rates that do not cover full costs in order to permit producers to enter a particular market area. The finely balanced

[21] Cf. Saul Nelson, *op. cit.* pp. 278, 296, and *passim.*

[22] Cf. chapter 18 of this report, "*Price Policies.*"

railroad rate relationships on sugar and other commodities that have persisted for many years involve a partial "absorption of production costs." Until 1934, at least, the same f. o. b. price was paid by cottonseed oil mills to all producers of cottonseed within specified zones, despite the fact that different transportation expenses were incurred from the various sources. In substance, the sources of cottonseed production were "grouped" and the same transportation charges made to each mill within the zone. Coal mines within zones of varying extent are commonly "grouped" by railroads and the same charge made from each mine within the "group," regardless of its distance from the market concerned. Similarly, all forms of transportation frequently make the same charges for transporting a commodity from its place of production to different markets at varying distances from it. In other words, points of destination are "grouped," with similar results so far as purchasers are concerned as those resulting from the zone system of prices established in many industries. Lower charges are often made by carriers for long hauls than for short hauls in the same direction and included within the former; industries at times charge lower prices to some buyers than to others, although freight to the former may be carried through the place at which the latter are located—and at a higher transportation charge.[23]

The above analogies between transportation rate policies and geographical pricing policies in other industries could be multiplied, but enough has been said to indicate the probability that the two sets of price systems are not independent of each other. During the N. R. A., minimum mill prices were established for lumber in areas other than the Southeast. In that section delivered prices involving freight absorption were established. One commentator has suggested that the reason for this difference, demanded by mills in the Southeast, was the fact that "freight rate groups [for lumber] in this territory (particularly in the Carolinas and Virginia) are smaller—thus bringing the effect of freight rate differentials more strongly to the attention of industry members in this area." [24] It has been suggested that the pattern of delivered steel prices would not be completely changed if the basing-point system of prices in the steel industry were outlawed, for carriers would introduce offsetting rate changes.[25] The practice of making the price of gasoline through a sizeable area in the Midwest equal to the base price at Tulsa, Oklahoma, plus the railroad freight rate to destination, had its origin in the fact that the railroad freight rate to any particular destination in the Midwest was the same [26] from all points of origin in the midcontinent producing area.[27] This pricing practice continues, although gasoline pipe lines have since been constructed and carry gasoline to destination at costs which vary with distance and are much lower than the railroad rates.[28] Indeed it is likely that the transportation rate structure and geographical pricing policies in certain industries are very intimately related so that a change in either one may result in offsetting changes in the other.

Not only do transportation rate policies and geographical pricing policies of industry sometimes offset each other, they also implement each other in other instances. Maintenance of the basing-point system in sugar refining would probably be impossible were it not for the rate adjustment that has been observed by railroads for many years. Even motor carriers sometimes make rates which enable firms to pursue, without change of location, one or another of the pricing policies described below.[29] The Interstate Commerce Commission permitted motor carriers to reduce rates on petroleum penetrating oil from Denver to eastern and southeastern points. The product is sold at nationally uniform delivered prices and the manufacturer at Denver had threatened to establish a branch plant in the East unless lower rates were set.[30]

The fact that carriers do not vary their charges precisely with costs and that the prices of producers do not vary precisely with transportation rates to various markets indicates the impossibility of interpreting location from a purely geographical point of view. In fact, differences in distance are frequently ignored by carriers in making their rates, and differences in transportation charges sometimes completely fail to be reflected in the prices of goods.

Influence of Transportation on Regional Development

One of the most interesting problems in which the effect of transportation costs on location is concerned

[23] Cf. *Report of the Federal Trade Commission with Respect to the Basing-Point System in the Iron and Steel Industry*, 1934, p. 18.

[24] Gustav Seidler, Jr., *The Control of Geographic Price Relations under the Code of Fair Competition*, N. R. A. Trade Practice Studies, Work Materials No. 86, 1936, p. 108.

[25] J. M. Clark and others, *Report of the National Recovery Administration on the Operation of the Basing-Point System in the Steel Industry*, 1934.

[26] The condition has existed for two decades. Cf. brief of Mr. Swenrud, Temporary National Economic Committee Hearings No. 15, exhibit 1206, p. 8707.

[27] Cf. Saul Nelson, *op. cit.*, part II, pp. 273–4.

[28] Apparently, however, this price structure is gradually breaking down as a result of "the development of new oil fields in Illinois, Michigan, and elsewhere." Temporary National Economic Committee Hearings No. 15, *loc. cit.*

[29] Cf. chapter 18 of this report, *"Price Policies."*

[30] Cf. *Western Territory Commodity Rates and Ratings*, 17 M. C. C. 511, 514, 1939.

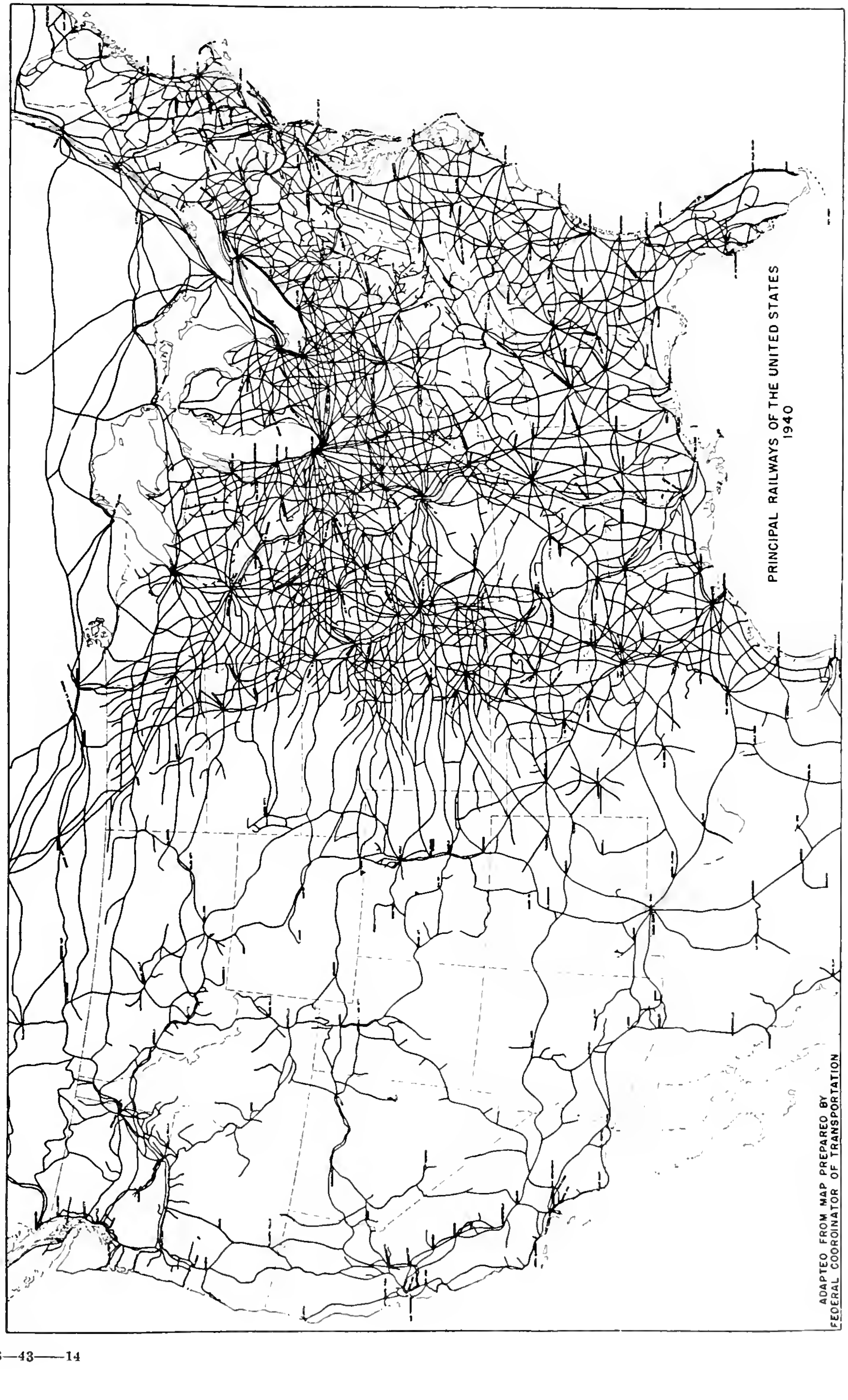

PRINCIPAL RAILWAYS OF THE UNITED STATES
1940
ADAPTED FROM MAP PREPARED BY
FEDERAL COORDINATOR OF TRANSPORTATION

FIGURE 78

relates to the economic development of the various regions of the country.

Regional development has been determined in large part by the nature and amount of proved reserves of natural resources with which each region has been endowed. It has depended, also, on the development of industrial, technological, and manufacturing techniques, which have enhanced the importance of the resources of some areas, and lessened the importance of those in others.

Among the most important natural resources are natural highways for transportation—oceans and bays, navigable rivers and lakes, and a terrain favorable to transportation by land—with which some regions have been abundantly endowed, and others only scantily provided. Transportation facilities that are relatively durable and immobile—for example, railways, canals, improvements to highways, bridges, airports, harbors, and other improvements made on natural waterways—may also be regarded in substantially the same light as natural resources of the region which they principally serve (cf. figures 78–81).

Rate structures, originally dictated by the economic conditions of the region served, tend to be self-perpetuating, for carriers in each region strive to protect the traffic that their rate policies have fostered against encroachments by carriers in other regions. An instance of this is the refusal of carriers in the Northeast to join with southern carriers in the quotation of relatively low through rates on northbound manufactured goods, which would thus be brought into competition with products of shippers on their own lines.[31] Indeed, counsel for the northern carriers stated, "Well, we don't put our case on transportation conditions. We rise or fall by this proposition; that in a case of this sort controlling standards are those which center from and radiate from rate histories and rate comparisons."[32]

Nevertheless rate structures are subject to continual change, although, relative to changes in the underlying economic conditions on which they are based, such change is slow. Carriers, especially railroads and steamship lines, frequently offer especially low rates in order to induce new industries to use their facilities; the industrial location department plays a very important role on many railroads. Public regulatory bodies, especially the Interstate Commerce Commission, have brought about changes in transportation rate structures and thereby have influenced the location of economic activities. Furthermore, new agencies of transportation, such as the highway carrier and the pipe line, tend to upset traditional systems of rates.

Although there has been a tendency for common carrier truckers to adhere rather closely to the rates developed by the railroads, their rate policies have shown marked deviations. In New England, motor carriers have tried to set their own rate structure with little regard for railroad theory.[33] Shippers operating their own trucks are likely to vary widely from railroad rate policies on the traffic which they carry. Moreover, potential as well as actual operation by shippers of their own trucks has influenced the rate structures of motor carriers and railroads. The influence of the market on the location of manufacturing has been lessened by greater competitive reductions in rates on fabricated products than on raw materials. The truck has also contributed largely to greater over-all speed of transportation in recent years, and thus has reduced the pull of the market. In some instances truckers have charged lower rates on eastbound and northbound manufactured goods, in order to balance their loads.[34] The extent to which this may result from limitations on the range of commodities which they have authority to carry is not clear. The petition of producers in the Southeast for lower rates on certain manufactured goods, however, was granted partially for the reason that manufactures would move to the North in any case,[35] inasmuch as producers find it often necessary to resort to the use of private trucks in order to extend their markets.

Certain tendencies toward greater regional diversification of economic activities may be partially accounted for by the relatively greater reductions in charges on short hauls than on long hauls. Short-haul trade has increased as a result. There are indications that many manufacturers formerly selling over rather wide areas have found their sales territory contracted.[36] On the other hand, relatively low short-haul rates by truck have increased the marketing radius of industries for which economies of large-scale production have not been fully exploited.[37]

Dominance of the Northeast

The fact of overwhelming significance in interpreting the influence of transportation service and charges on regional development in the United States is the great concentration of population and manufacturing in the Northeast. The location of about three-fourths

[31] Cf. *State of Alabama et al.* v. *The New York Central R. R. Co., et al.*, 235 I. C. C. 255, 329, 1939.

[32] *Ibid.*, p. 317.

[33] *New England Motor Carrier Rates*, 8 M. C. C. 287, 1938.

[34] Cf. *Western Territory Commodity Rates and Ratings*, 17 M. C. C. 511, 1939.

[35] *State of Alabama et al.* v. *The New York Central R. R. Co. et al.*, 235 I. C. C. 255, 327–8, 1939.

[36] Cf. A. Hamilton Chute, *Marketing Burned Clay Products*, Ohio State University, Columbus, 1929, pp. 201,220.

[37] Cf. Miriam E. West, *Productivity and Employment in Selected Industries; Brick and Tile*, Works Progress Administration, 1939, pp. 64–66.

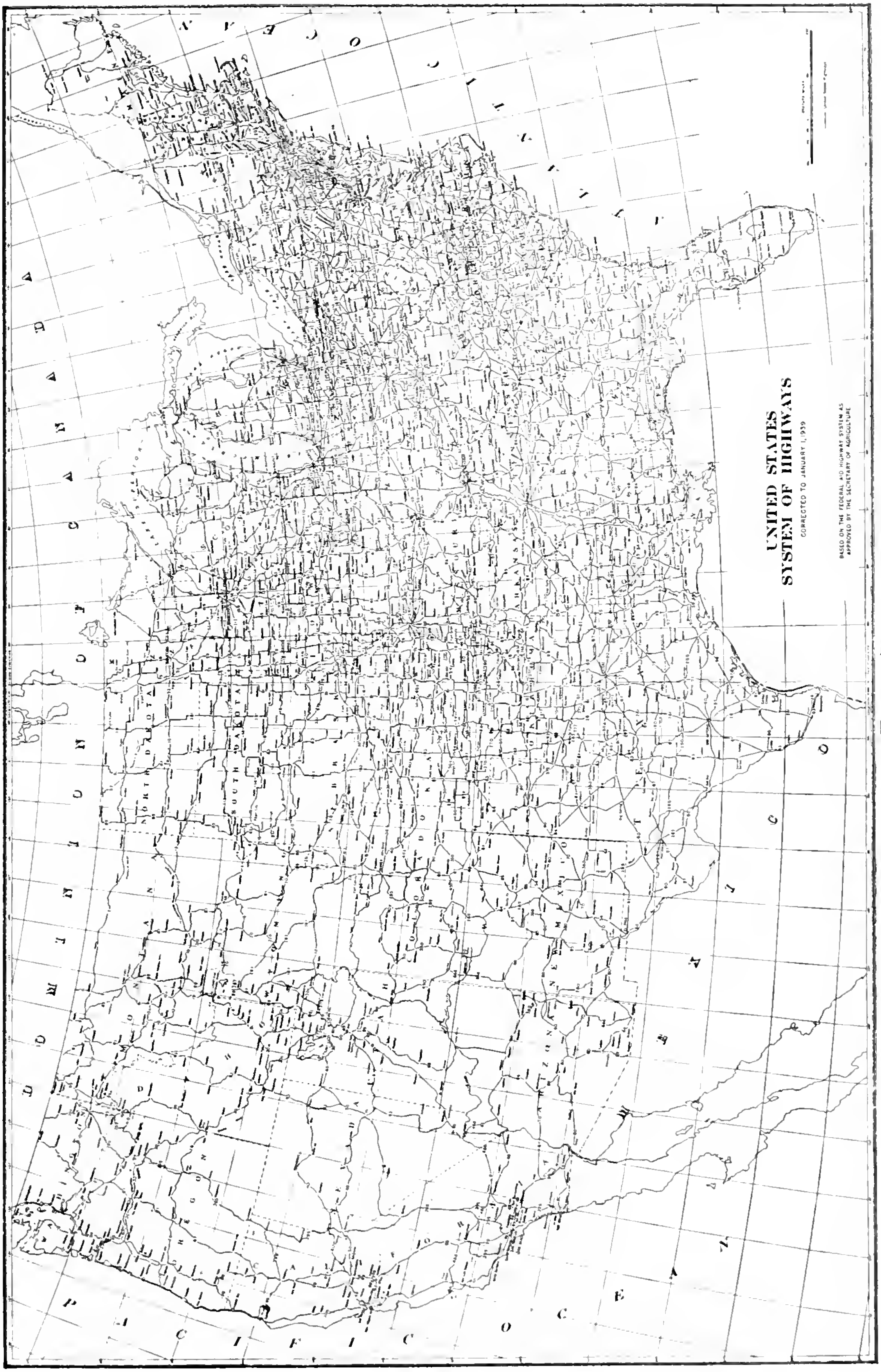

UNITED STATES
SYSTEM OF HIGHWAYS
CORRECTED TO JANUARY 1, 1939
BASED ON THE FEDERAL AID HIGHWAY SYSTEM AS APPROVED BY THE SECRETARY OF AGRICULTURE
DOMINION OF CANADA
PACIFIC OCEAN

FIGURE 79

of the nation's manufacturing enterprise within 14 northeastern States provides an extremely favorable market for the raw materials produced there, and the area is rich in natural resources, especially the strategic coal and iron resources so located as to permit assembly at relatively low transportation charges. Concentration of manufacturing activity in the Northeast is partially accounted for by the large consuming market that the area provides, together with its accessibility to the large foreign market in eastern Canada and Europe.

Even if the level of transportation rates were no lower and service no better in the Northeast than in other parts of the country, relatively low transportation charges to market would favor raw material producers there in competition with producers elsewhere who were also striving for that market. The same conclusion is relevant for manufacturers producing for the Northeast market.

There is no question that the level of railroad class rates[38] is very much lower in the Northeast than in other sections of the country· but a much larger percentage of total freight traffic in the Northeast moves on class rates. The Interstate Commerce Commission has indicated that class rates set by highway carriers for hauls in the Middle Atlantic and East Central States are "materially lower" than such rates for comparable distances within New England and within the Southeast. As it said, "Such results must be expected, because the motor carrier class rates throughout the country follow more or less closely the competitive rail class rates and the latter reach their lowest level in the Middle Atlantic and East Central States."[39]

The Northeast is also favored by the existence of excellent water transportation facilities. Charges for transportation on the Great Lakes are very low, for example. Moreover, river and canal improvements, with consequent low transportation rates, have been especially noteworthy in that area. Intraterritorial trade is furthered, also, between points to which coastal service is available as it is along the Atlantic coast. The magnitude of economic activities carried on in the Northeast is attributable in large part to its excellent location with reference to the European market, and the excellent harbors and shipping facilities that dot the Atlantic coast. Moreover, materials from the Southeast, Southwest, and the Pacific coast areas of the country are obtainable at very low water transportation rates—lower in fact than is true of interior sections of the country which are geographically closer—whereas certain kinds of manufactured goods are in turn carried by water at relatively low back-haul rates to those areas.

Influence of Transportation on Urban Concentration

Transportation has probably had more influence on the relative size of urban communities than on the interregional distribution of production since the latter has been very largely determined by the relative endowments of various regions in natural resources and by the relative magnitude of their consuming populations. If a particular site enjoys more favorable transportation rates on raw materials and on processed goods than the localities in the surrounding area, manufacturing activities will gravitate to it and away from the surrounding communities, unless other costs of production become sufficiently higher to offset the transportation cost advantages. Similarly, more frequent, more dependable, more convenient and speedier service afforded by carriers to a particular site than to surrounding areas will attract additional production. As already stated, the importance of relatively low transportation costs to and from a particular site will be greater the greater the economies of large-scale production and other cost advantages. The location of productive enterprise at a particular site provides a further attraction to industries, which for transportation reasons tend to be located at the market.[40] All large cities and, in fact, medium sized cities as well have been favored by good transportation facilities.

An important factor in the growth of large cities has resulted from the superior service and advantageous rates afforded by carriers in competition for traffic. According to Mr. A. B. Stickney, "Statistics show that the entire net increase of population from 1870 to 1890—in Illinois, Wisconsin, Iowa, and Minnesota—was in cities and towns possessing competitive rates; and further, that all the noncompetitive towns and villages decreased in population."[41]

Service

Significant differences exist in the quality of transportation services available to various localities. Not all localities are directly served by all kinds of transportation agency. The commercial air routes, for example, afford direct service to fewer than 300 communities. The number of gasoline and crude oil pipe line terminals is relatively small. Carriage by water is, of course, immediately available to relatively few communities. The Automobile Manufacturers' Association annually reports that more than 40,000 communities are without railroad service and dependent upon motor-vehicle operations. (Cf. figures 78 and 79.)

[38] A class rate is a rate imposed on a category of commodities, while a commodity rate relates to a particular commodity rather than to a group of goods.

[39] *Rates over Freight Forwarder, Inc.*, 4 M. C. C. 68, 1937.

[40] Cf. ch. 14.

[41] *The Railway Problem*, St. Paul, 1891, p. 62.

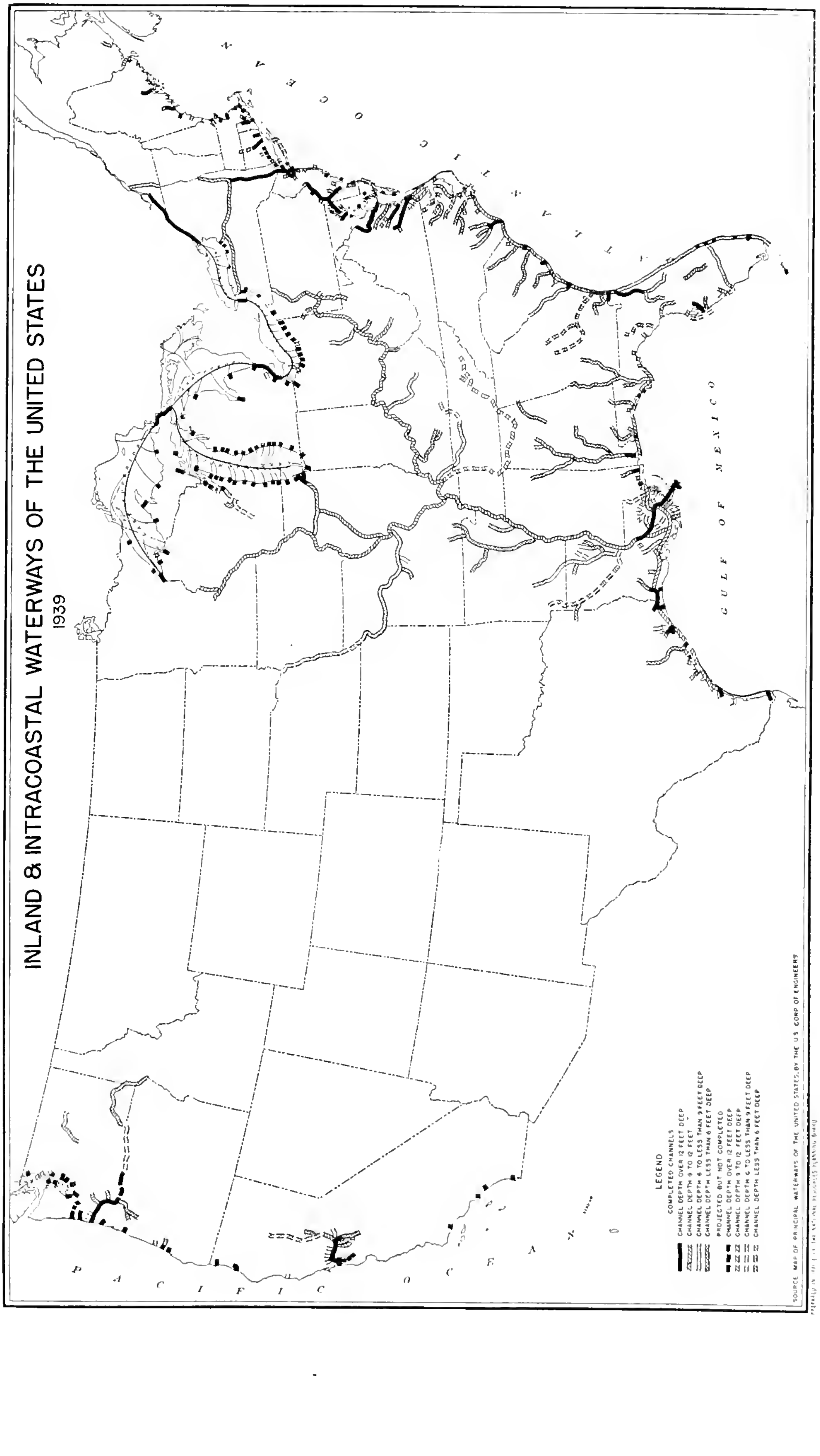

INLAND & INTRACOASTAL WATERWAYS OF THE UNITED STATES
1939
ATLANTIC OCEAN
GULF OF MEXICO
PACIFIC OCEAN
LEGEND
COMPLETED CHANNELS
CHANNEL DEPTH OVER 12 FEET DEEP
CHANNEL DEPTH 9 TO 12 FEET
CHANNEL DEPTH 6 TO LESS THAN 9 FEET DEEP
CHANNEL DEPTH LESS THAN 6 FEET DEEP
PROJECTED BUT NOT COMPLETED
CHANNEL DEPTH OVER 12 FEET DEEP
CHANNEL DEPTH 9 TO 12 FEET DEEP
CHANNEL DEPTH 6 TO LESS THAN 9 FEET DEEP
CHANNEL DEPTH LESS THAN 6 FEET DEEP
SOURCE MAP OF PRINCIPAL WATERWAYS OF THE UNITED STATES, BY THE U S CORP OF ENGINEERS

FIGURE 80

There is little doubt that large communities have better transportation than smaller centers. Shippers in very small communities are placed at a disadvantage because information concerning transportation schedules and rates is not always readily available to them, especially if there is no local transportation agent. The files of the Iowa Commerce Commission disclose that almost as much opposition is encountered from shippers to the withdrawal of a local railroad agent as to the abandonment of a branch. Moreover, in large urban centers the chambers of commerce frequently perform the functions of industrial traffic managers for their members. Railroad, common-carrier truck, water carrier, and air freight schedules are typically made with a view to the convenience of producers located at major terminals. Greater convenience and over-all speed of transportation are also afforded producers as a result of the more frequent schedules operated by carriers competing for traffic between large cities. Frequency of schedules results also from the very magnitude of the traffic hauled between such places. Smaller communities along railway and highway routes are frequently bypassed in the interest of fast service between large communities. The result is a differential advantage in speed and frequency of transportation for the large communities. Freight forwarders and the Railway Express Agency also have contributed to better service between localities of major traffic importance.

The increase in transportation speed in recent years has rendered more profitable the concentration of merchandising activities in the largest cities, to the disadvantage of even relatively large trading centers. In explanation of the decline of warehousing in Minneapolis, Professors Vaile and Nordstrom write, "the general improvement in transportation service has operated to permit manufacturers to consolidate their warehouse stocks at the more important distribution centers. The time on carload shipments (between Chicago and Minneapolis) has been reduced from 3 or 4 days to 36 hours. As a result in some lines it is no longer necessary to carry stocks of merchandise in both Chicago and the Twin Cities." [42]

Rates

Most of the major manufacturing and trading centers of the country have ready access to cheap water transportation. Boston, New York, Philadelphia, Baltimore, and San Francisco, for example, are located on excellent harbors for ocean-going vessels. In addition, New York City is especially favored by its location on the Hudson River. Chicago, Buffalo, Cleveland, and Detroit benefit from the low costs of transportation on the Great Lakes. St. Louis owes much of its prosperity to its location at the confluence of the Mississippi and Missouri Rivers, and the advantages of Pittsburgh for manufacturing arise partially out of a like circumstance. Dr. Glenn E. McLaughlin has indicated that "about half of the [major manufacturing] areas are located on deep water, and many of the remainder have access to navigable rivers." [43] Such locations afford great advantages in the assembly of materials for manufacturers over places not so favored. Moreover, producers and merchants located there are also favored in marketing products for which speed is not of great importance.

Because of their desire to divert traffic away from water carriers, railroads frequently charge producers at ports less than competitors at intermediate places inland. Pacific coast cities, situated on or near harbors, are frequently favored by railroads in this fashion. In numerous instances, the Interstate Commerce Commission, acting pursuant to law, has permitted railroads to make such charges.

The practice of charging less for long hauls than for shorter hauls in the same direction and included within them is not confined to instances where railways and waterways compete for traffic. It is a common occurrence also in the competition of railroads with one another, with motortrucks or with petroleum pipe lines, and of these various agencies with one another as well.[44] In some instances at least, truck operators maintain that higher rates to intermediate cities than to large terminal cities are justified because of higher costs entailed in serving the former. In *New England Motor Carrier Rates*,[45] it was shown that often goods were actually transported through to major terminal cities and hauled back to the intermediate cities concerned. Moreover, many truck operators "handle traffic principally in truckloads between important commercial centers only and are thereby able to cut rates on such traffic." [46] Although the amount of air freight traffic is as yet relatively insignificant, it is nevertheless of some importance for certain kinds of manufactured products and is available only to major centers.

[42] *Public Merchandise Warehousing in the Twin Cities*, University of Minnesota, Studies in Economics and Business, Bulletin No. 3, 1932, p. 40.

[43] *Growth of American Manufacturing Areas*, University of Pittsburgh, Bureau of Business Research Monographs, No. 7, 1938, p. 13.

[44] No provision appears in the Motor Carrier Act of 1935, analogous to the so-called Fourth Section of the Interstate Commerce Act, prohibiting charges that are greater on long hauls than on short hauls when the latter are included within the former. The Interstate Commerce Commission can, of course, prohibit such a practice if it finds that it results in unjust discrimination against shippers located at intermediate cities. Specific prohibition of such practices by water carriers subject to regulation by the Commission was included in the Transportation Act of 1940.

[45] 8 M. C. C. 287, 297, 1938.

[46] Cf. *Central Territory Motor Carrier Rates*, 8 M. C. C. 233, 253, 1938.

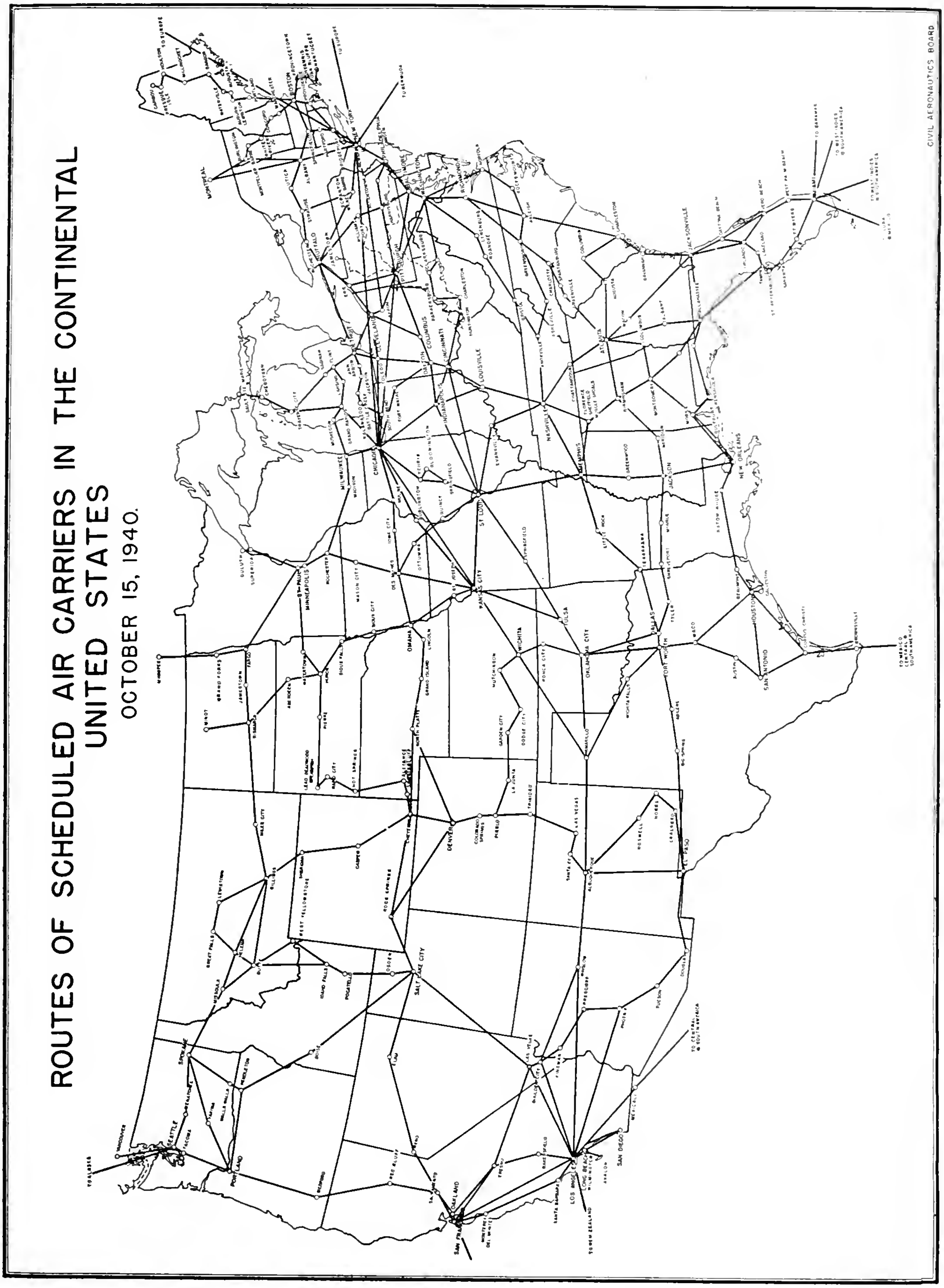

ROUTES OF SCHEDULED AIR CARRIERS IN THE CONTINENTAL UNITED STATES
OCTOBER 15, 1940.
CIVIL AERONAUTICS BOARD

FIGURE 81

Discouragement by the Interstate Commerce Commission, acting under congressional mandate, of the practice of charging more for short than for long hauls where the former are included within the latter has resulted in another rate-making policy, which also tends to attract industry to major centers. Railroads commonly make relatively low rates on traffic to and from "key" cities, as the Commission calls them, and blanket such rates back over an intermediate area of greater or lesser extent.[47] If the intermediate area concerned were the same on hauls in all directions, the "key" cities would have no advantages over other cities in the same area. In fact, however, the "key" cities do enjoy a transportation rate advantage over neighboring cities. A simple illustration will suffice to bring out the main details of this system of disparate blanketing.

A *D* *C* *E* *B*

Let us assume that *C* is a "key" city and *A* and *B* are sources of raw materials. *D* and *E* are other points served by the railroad concerned. On traffic from *A*, charges to all points between *D* and *C*, inclusive, are the same, but those to *E* beyond are higher; on traffic from *B*, charges to all points between *C* and *E*, inclusive, are the same, but those to *D* beyond are higher.

It can readily be seen that a manufacturing enterprise that requires raw materials from both *A* and *B* will find *C* a more advantageous location, so far as assembly costs are concerned, than either *D* or *E*. Moreover, *E* is in no more favorable position than *C*, for sales to *B*, whereas its position is inferior in marketing to *A*; a similar relationship obtains between *D* and *C*. Thus a system of "blanketing," which in every direction favors a "key" city, affords manufacturers located there decided advantages in transportation charges over competing cities in its territory.

The position of *C* would be even more advantageous if a number of transportation routes converged on it and similar "blankets" were provided on the various routes. In fact, such a convergence of routes on a city is frequently the occasion for the establishment of "key" rates because of competition in marketing and purchasing among producers along the various routes. The size of urban concentrations enjoying "key" rates depends, of course, on the extent of the "blankets" and on the amount of trade and manufacture carried on in the region in which the city so favored is located. Obviously a city of the size of New York could not be expected in the Great Plains region.

[47] Cf. *Western Truck Line Class Rates*, 164 I. C. C. 1, 208–9, 1930; and *Eastern Class Rate Investigation*, 164 I. C. C. 364, 414–15, 1930.

Blanketing of rates in this fashion is also practiced by motor carriers—sometimes over rather long distances. The same rate was charged from Winston-Salem, N. C., to Greenville, N. C., 188 miles, as from the former point to Nashville, Tenn., 645 miles. The Commission held that the rate to the latter point was unreasonably low.[48] But it has approved of this form of rate making by motor carriers in numerous cases.[49]

Even where cities are not favored by "key" rates, the policy of charging rates that vary less than in proportion to distance also may render advantageous the location of manufacturing plants at a city where several transportation routes, serving different material sources and different markets, converge, and where rates break.[50] Manufacturing and trade will tend to be located at such a place, to serve the surrounding area, if economies of scale exist.[51]

The creation of rate "zones" has a restrictive effect on the size of cities. The old Texas common-point system created a very broad area in that State within which transportation charges were equalized for traffic to and from designated outlying points. As a result, a much larger number of trading and manufacturing centers were established than would otherwise have been the case, and no single urban area was able to assume dominant importance in the State. Although the establishment of this zone system of rate-making was primarily a result of the peculiar interlacing of independently owned railroad routes and the competitive relationships resulting therefrom, the policy of the Texas Railroad Commission in its early days seems also to have been a major factor. "It was the idea of Judge Reagan, in his time the dominant statesman of Texas, that it would be inimical to the welfare of the State to have its merchandise distributed from one to two great distributing centers."[52] Prof. D. P. Locklin has suggested that the "blanketing of rates to and from all points in New England when the points of origin or destination were in the West has long had a decentralizing effect on industry in New England."[53]

[48] Cf. *Cotton Clothing and Underwear in the South*, 10 M. C. C. 691, 698, 1938.

[49] Cf. *Central Territory Motor Carrier Rates*, 8 M. C. C. 233, 250, 1938, and *New England Motor Carrier Rates*, 8 M. C. C. 287, 397, 1938.

[50] A rate-breaking point exists when traffic moves beyond it from any direction on a combination of local rates to and from it rather than on a lower through rate for the entire distance. It is a "constructive" break in transportation.

[51] In-transit privileges may offset the rate advantages enjoyed by large cities and may encourage industrial decentralization. The location of cotton compresses in small inland cities in Texas was for years encouraged by such means; but the motortruck has largely nullified the privilege in this case and has fostered the location of compresses at the ports in that state.

[52] L. G. McPherson, *Railroad Freight Rates in Relation to the Industry and Commerce of the United States*, New York, 1909, p. 93.

[53] *Economics of Transportation*, Business Publications, Inc., Chicago, 1935, p. 120.

Zoning seems to have been much more commonly followed by railroads in the past. Ex-Senator Hastings, of New York, has proposed that the country be divided into a number of zones for railroad rate-making purposes. Zoning on a relatively narrow scale occurs by virtue of the railroad policy of extending the same rates to all points within the terminal limits of a city, which in many cases extend beyond its political boundaries. The result is that, so far as transportation rates are concerned, location anywhere within the terminal limits is equally advantageous. The relatively extensive economic development of the suburbs of Chicago has been attributed to the fact that the Chicago terminal area is rather wide.[54] The establishment of free pick-up and delivery service by railroads in recent years has reduced the influence of cheap transportation rates on location in the heart of urban areas, and establishment of similar service by water carriers has influenced the movement of industry to the suburbs of major port cities.

The Railway Express Agency uses the zone system of rate making at the present time. It seems that the establishment of rate zones of rather large extent for parcel post was partially responsible for the development of large mail-order businesses after 1913.

Influence of Passenger Transportation on Location

The quality of passenger transportation and its cost are also influential in the location of economic activities. An important expense in many businesses is that incurred for travel by salesmen. Not only the actual transportation charges paid, or the costs of operating company-owned vehicles, but the time consumed in travel are all-important. Greater speed of transportation increases the number of accounts and the size of the sales territory that can be handled by a salesman, with reductions in the cost of marketing. If there are no offsetting increases in rates, producers are in a favorable position to penetrate new markets.

The establishment of branch plants is facilitated by speedy passenger service enabling executives to visit them with little loss of time. Commercial air service seems to be desired at sites for branch plants in several industries, although such problems have been solved in other cases by companies purchasing their own airplanes.[55]

Improvements in passenger transportation and reductions in its cost also facilitate labor supply. Thus low-cost, convenient, and speedy travel by motor vehicle over improved roads has increased the commutation radius of labor. Trends of manufacturing in recent years to the suburbs of industrial cities are partially attributable to this factor.

Consumers frequently travel to obtain goods and services which they require. It has been estimated that 9.4 percent of total consumer expenditures in 1935–36 were for travel.[56] The prosperity of vacation centers is very largely dependent on convenient and cheap transportation. The motor vehicle and improved roads have redounded to the advantage of certain sections of the country, northern New England for example, as recreation areas, but some other once prosperous resorts have suffered as a result.

Great differences exist in the quality of passenger service furnished various communities. Air transportation, for example, is available only to the largest centers. Faster passenger-train schedules often ignore smaller centers, which are bypassed. On the other hand, service differences among nearby communities have been largely eliminated as a result of individual ownership of motor cars.

The motor vehicle and the improved highway have apparently caused very small villages to lose much of their economic usefulness at trading centers. An investigation made in 1932 disclosed that in the West Mid-Continent, "the present trend of retail furniture trade is toward the larger cities" and that "towns of less than 7,500 people are relatively less important in furniture distribution than in other lines of retailing. Until perhaps 5 or 8 years ago, towns as small as 2,500 people seem to have been able to sell their proportionate share of furniture."[57] In this connection, the passenger automobile has probably been quite as important as the motor truck. A recent survey discloses that about 10 percent of all passenger cars are used for shopping from 8 to 18 miles from home and that about 7 percent of them go more than 30 miles from home.[58]

Summary

Transportation is of special importance in the location of economic activities. Both the relationships ob-

[54] Cf. William N. Mitchell, *Trends in Industrial Location in the Chicago Region Since 1920*, University of Chicago, Studies in Business Administration, vol. IV, 1933, p. 69.

[55] Recent decisions in the airplane-manufacturing industry to establish branch plants were apparently made partially on the ground that key executives could be transported speedily between the main plant and the branches. The Douglas Aircraft Corporation, for example, maintains "an aerial bus service between the factories to transport its key executives, technicians, and even necessary parts and small machinery by air." *Industrial Los Angeles County*, Los Angeles Chamber of Commerce, November–December 1940, p. 4.

[56] Cf. National Resources Committee, *Consumer Expenditures in the United States*, 1939, table 7A, pp. 79.

[57] Walter Mitchell, Jr., *Furniture Distribution in the West Mid-Continent*, U. S. Bureau of Foreign and Domestic Commerce, Domestic Commerce Series No. 68, 1932, p. 16.

[58] Automobile Manufacturers Association, *A Factual Survey of Automobile Usage*, Detroit, 1941, p. 30.

taining between specific rates and the level of rates in general influence the geographical distribution of various kinds of economic enterprise. Not only are rates important in this regard, the service rendered by carriers is also a factor of consequence; time, for example, is one of the costs of transportation.

The relative immobility of productive factors and the complex relationships, locational as well as others, that constitute the economic system sometimes operate to offset the influence of changes in transportation costs on location.

The effects of changes in transportation costs on location are frequently offset, also, by industrial pricing policies, which do not fully reflect differences in transportation costs. In fact, there is some evidence that industrial price systems and transportation rate policies are not independent of each other; in some cases, changes in one set are offset by changes in the other, whereas in other instances, the two sets of prices apparently implement each other—with significant effects on location.

Transportation has probably had more influence on the relative size of urban communities than on the interregional distribution of production. Significant differentials, both in rates and in service, have existed between cities of various size, with resultant differences in the transportation costs involved in doing business. Most large industrial cities have been favored by excellent transportation facilities and by competitively depressed rates.

The quality of passenger transportation and its cost are also influential in the location of economic activities. The most important locational influence of passenger transportation is on the size of urban concentrations and the degree of suburbanization. Great differences exist in the quality of passenger service available to various communities.

CHAPTER 10. MARKETS AND MARKETING

By Wilbert G. Fritz *

Locational patterns of industry reflect in marked degree the influence of the flow of commodities through the marketing system. This flow between establishments, unlike that within a manufacturing plant, is not subject to rigid direction or control. Each stage in the distribution process constitutes a market more or less closely related geographically and functionally to the preceding stage. Markets consist of ultimate consumers, or of intermediary organizations that handle the commodities either for ultimate consumer use or for furthering production and distribution. Certain establishments, such as those engaged in bread baking, ice cream production, and newspaper publishing, are clearly oriented toward ultimate consumers' markets. Other establishments, for example, many machine shops, steel fabricators, and box manufacturers, are oriented toward intermediate markets, which consist of producing or bulk distributing establishments. A third class, illustrated by wood pulp, aluminum, and leather-goods producers, are less influenced by markets than by supply of materials, power, labor, and economies of large-scale production.[1]

Individual establishments cannot exercise substantial control over the location of the demand for their products but instead must choose locations with an eye on possible outlets. Marketing activity is influential not only through its effects on the producing branches of industry but also through its own importance as an economic activity. Marketing, broadly defined to include wholesale and retail trade, transportation and communication, produced in 1940 more than one-fifth of the national income; wholesale and retail trade alone produced about one-seventh of the total income.[2] By comparison the proportion of national income in 1940 produced by manufacturing was almost one-fourth of the total, and that produced by agriculture and mining combined was about one-tenth. Gainful workers in marketing (trade, transportation, and communication) in 1930 aggregated approximately one-fifth of all gainful workers.[3] Marketing activity has been increasing relatively, as is indicated by the fact that in 1870 the proportion of gainful workers engaged therein was only one-ninth. From 1870 to 1930 the number of workers in marketing almost kept pace with the ninefold expansion of the physical volume of goods produced, whereas the number of workers engaged in production increased less than threefold.[4]

The organization of marketing may help to determine the best locations for industry. Reduction of the number of middlemen, for example, would have a profound effect because it would disturb the existing lines of contact between producers and consumers. A change in the type of middlemen would likewise affect the locational adjustments, but in most cases to a lesser extent.

In a dynamic society, manufacturing, the branch of economic activity of special importance in industrial location, and other economic activities as well are continually readjusting themselves to market demands. These markets, in turn, reflect the combined influence of such factors as general marketing organization and practices, the nature of the product (e. g., perishability or bulkiness in relation to value), the location of the immediate users of the product (whether intermediaries or ultimate consumers), regional levels of income, the state of the arts, consumer tastes and habits, and trade barriers at home and abroad. Producers, by their own efforts, can do comparatively little to modify these basic factors. Market patterns, in other words, are largely shaped by circumstances beyond their control. A concern could not expect, for example, to build a satisfactory market for industrial machinery in an area devoted to agriculture and in which the development of urban activity would be unlikely. The concern would instead direct its efforts toward the areas that have predetermined possibilities. Thus, in making locational adjustments, markets are accepted primarily as given quantities.[5] A discussion of markets as a locational determinant must resolve itself accordingly into a study of the ways in which underlying factors mold market structures and so influence the choice of a location for the individual concern.

This chapter will consider the following factors as they relate to location: (1) market patterns; (2) tend-

*Principal Economist, National Resources Planning Board.

[1] National Resources Committee, *The Structure of the American Economy, Part I*, Washington, 1939, pp. 264–69.

[2] Milton Gilbert and Dwight B. Yntema, "National Income Exceeds 76 Billion Dollars in 1940," *Survey of Current Business*, June 1941, pp. 14–17; and N. H. Engle, "Costs and Profits in Marketing," *Annals of the American Academy of Political and Social Science*, May 1940, p. 125.

[3] Engle, *op cit.*, p. 125; and Paul W. Stewart and J. Frederic Dewhurst, *Does Distribution Cost Too Much?* The Twentieth Century Fund, New York, 1939, pp. 9–11.

[4] Stewart and Dewhurst, *op. cit.*, pp. 12–13.

[5] This does not mean, of course, that markets are not in turn influenced by the efforts of producers. Trade is a result of interaction.

encies in marketing; (3) the flow of goods to markets; (4) the concentration and dispersion process; (5) the relationship of markets to production; (6) the relationship of buying and selling units; (7) initiative in transactions; and (8) the division of business among marketing units.

Market Patterns

The distribution of retail sales among counties in the United States is shown in figure 82. These sales show a rather close correspondence to the distribution of population. The level of income and the character of expenditures influence the pattern. Areas of relatively high average income naturally have a large volume of retail sales per capita. These sales do not, however, increase in direct proportion to income, for the larger the income the greater the proportion spent in other ways than on retail commodity purchases. Moreover, the high income areas usually have a net outflow of capital More detailed data than those presented for counties in figure 82 indicate that retail sales usually increase more than proportionally to the size of the trading center. Although this accelerated rise reflects in part higher living costs in the larger centers, it also indicates greater pulling power of trade. Within any given area, however, the attraction of competing centers must also be taken into account. A town located in a large area with no strong competing centers will become the dominant center for the area. Many agricultural shopping centers are of this type and have a relatively high proportion of the local population engaged in trade. Except for mail-order retail sales, the retail area is limited by the inconvenience and cost of traveling to outside market centers. Generally, transportation is better to the large centers than to the small ones, although congestion may be a deterrent to development, especially in the central business districts of large cities. The spread of automobile transportation has widened greatly the retail areas for centers that can offer special inducements of price or variety.[6]

The geographic spread of individual retail markets is so narrow that intra-area concentration is not so important to location of industry as the distribution among areas. Since a manufacturing plant usually distributes to a large number of individual retail markets, it would seldom change its location in response to a shift of retailing within any one of these markets. Its location may be determined by the relative size of areas but little if any by the interior pattern of each area.

[6] Horace Secrist, *The Widening Retail Market*, Bureau of Business Research, Northwestern University, Chicago, 1926.

Wholesale trade is more concentrated geographically than retail trade (fig. 83). States with a dense population have a disproportionately large share of wholesaling as a rule. Among urban centers the gains in the importance of wholesale trade have been more rapid than gains in population. In 1939 New York City had 23 percent of the total wholesale sales of the country, but only five and one-half percent of the population. Chicago had seven and one-half percent of the sales but only two and one-half percent of the population. It should be remembered, however, that some wholesale trading takes place without any physical flow of goods through the hands of the wholesalers. The data on wholesaling undoubtedly exaggerate the concentration in physical flow.

The distribution of wholesale sales differs considerably from the distribution of population (table 1). Only 10 States, including the District of Columbia, have a relative wholesale sales density greater than the population density. They are: Massachusetts, New York, Delaware, and the District of Columbia along the Atlantic seaboard; Illinois, Minnesota, Nebraska, and Missouri on the western side of the manufacturing belt; and California and Washington on the Pacific coast. All of these States are either along the seaboard, where foreign trade may have an influence, or in the transition zone between the manufacturing belt and the western half of the United States. The District of Columbia is an exceptional case owing to its lack of rural population. Only 6 States (New York, Illinois, California, Missouri, Massachusetts, and Minnesota) have a density of wholesale sales much above the average. New York State alone has 26.25 percent of the Nation's wholesale sales, as compared with 10.24 percent of the population.

The relative distributions of retail and wholesale sales; of the value of manufactures, minerals, and agricultural production; and of population and land area among States are shown in table 1. Coefficients of geographic linkage for pairs of items are shown in table 2 in the order of decreasing coincidence of relationship by States.[7] The highest coefficient among the series compared was 88.89, for retail sales and population; and the lowest was 42.32 percent, for the value

[7] Perfect coincidence in location among the States would be represented by 100 percent. To attain this level States not only would have to rank in the same order for the two items compared but also would require exact agreement in the percentage of the national total for each pair of items. Complete disagreement, represented by a zero coefficient, would mean that each State having a positive figure for one item would have zero for the other. In actual practice the distribution of comparative factors is more likely to approach complete agreement than complete disagreement. A zero coefficient for the relative distribution of land area and manufacturing or population and manufacturing, for example, is an impossibility, because area and population must be distributed to some extent where manufacturing is located. Refer to chapter 5 for other applications of this measure.

TABLE 1.—*Relative distribution of sales, value of production, population and land area, by States, 1939*

State	Percent of United States total: Value of retail sales	Value of wholesale sales	Value of manufacturing production	Value of mineral production	Value of agricultural production	Population (April 1940)	Land area	Differences in percentage distributions (points) between— Retail sales and—: Wholesale sales	Retail sales and—: Population	Retail sales and—: Area	Wholesale sales and—: Manufacturing production	Wholesale sales and—: Population	Wholesale sales and—: Area	Manufacturing production and—: Mineral production	Manufacturing production and—: Agricultural production	Manufacturing production and—: Population	Manufacturing production and—: Area	Mineral production and—: Population	Mineral production and—: Area	Agricultural production and—: Population	Agricultural production and—: Area	Population and area
Alabama	1.04	0.75	1.01	1.24	1.61	2.15	1.72	+0.29	−1.11	−0.68	−0.26	−1.40	−0.97	−0.23	−0.60	−1.14	−0.71	−0.91	−0.48	−0.51	−0.11	+0.43
Arizona	.38	.17	.17	1.78	.61	.38	3.81	+.21	0	−3.43	0	−.21	−3.61	−1.61	−.47	−.21	−3.64	+1.40	−2.03	+.26	−3.17	−3.43
Arkansas	.71	.45	.28	.70	1.92	1.48	1.77	+.26	−.77	−1.06	+.17	−1.03	−1.32	−.42	−1.61	−1.20	−1.49	−.78	−1.07	+.41	+.15	−.29
California	7.58	6.95	4.92	11.11	6.72	5.25	5.27	+.63	+2.33	+2.31	+2.03	+1.70	+1.68	−6.19	−1.80	−.33	−.35	+5.86	+5.84	+1.47	+1.45	−.02
Colorado	.97	.79	.39	1.52	1.46	.85	3.49	+.18	+.12	−2.52	+.40	−.06	−2.70	−1.13	−1.07	−.46	−3.10	+.67	−1.97	+.61	−2.03	−2.64
Connecticut	1.71	.75	2.16	.10	.68	1.30	.16	+.93	+.41	+1.55	−1.41	−.55	+.59	+2.06	+1.48	+.86	+2.00	−1.20	−.06	−.62	+.52	+1.14
Delaware	.26	.28	.20	.01	.22	.20	.07	−.02	+.00	+.19	+.08	+.08	+.21	+.19	−.02	0	+.13	−.19	−.06	+.02	+.15	+.13
District of Columbia	.95	.63	.14	.01	(1)	.50	(2)	+.33	+.46	+.96	+.49	+.13	+.63	+.13	+.14	−.36	+.14	−.49	+.01	−.50	(2)	+.50
Florida	1.46	.95	.42	.31	1.54	1.44	1.82	+.51	+.02	−.36	+.53	−.49	−.87	+.11	−1.12	−1.02	−1.40	−1.13	−1.51	+.10	−.28	−.38
Georgia	1.49	1.46	1.19	.35	2.11	2.37	1.97	+.03	−.88	−.48	+.27	−.91	−.51	+.84	−.92	−1.18	−.78	−2.02	−1.62	−.26	+.14	+.40
Idaho	.42	.19	.16	.79	1.06	.40	2.78	+.23	+.02	−2.36	+.03	−.21	−2.59	−.63	−.90	−.21	−2.62	+.39	−1.99	+.66	−1.72	−2.38
Illinois	6.80	9.04	8.44	5.00	5.80	6.00	1.88	−2.24	+.80	+4.92	+.60	+3.01	+7.16	+3.41	+2.61	+2.41	+6.56	−1.00	+3.12	−.20	+3.92	+4.12
Indiana	2.51	1.53	3.92	1.27	3.20	2.60	1.22	+1.01	−.06	+1.32	−2.39	−1.07	+.31	+2.65	+.72	+1.32	+2.70	−1.33	+.05	+.60	+1.98	+1.38
Iowa	1.96	1.43	1.26	.61	6.81	1.93	1.88	+.53	+.03	+.08	+.17	−.50	−.45	+.65	−5.55	−.67	−.62	−1.32	−1.27	+4.88	+4.93	+.05
Kansas	1.13	.77	.82	2.93	3.02	1.37	2.76	+.36	−.24	−1.63	−.05	−.60	−1.99	−2.11	−2.20	−.55	−1.94	+1.56	+.17	+1.65	+.26	−1.39
Kentucky	1.24	.84	.85	2.69	2.05	2.16	1.35	+.40	−.92	−.11	−.01	−1.32	−.51	−1.84	−1.21	−1.31	−.50	+.53	+1.34	−.10	+.71	+.81
Louisiana	1.16	1.28	.99	4.01	1.54	1.80	1.52	−.12	−.64	−.36	+.29	−.52	−.24	−3.02	−.55	−.81	−.53	+2.21	+2.49	−.26	+.02	+.28
Maine	.67	.30	.61	.09	.67	.64	1.04	+.37	−.03	−.37	−.31	−.34	−.74	+.52	−.06	−.03	−.43	−.55	−.95	+.03	−.37	−.40
Maryland	1.47	1.25	1.81	.28	.86	1.38	.33	+.22	+.09	+1.14	−.56	−.13	+.92	+1.53	+.95	+.43	+1.48	−1.10	−.05	−.52	+.53	+1.05
Massachusetts	4.13	4.04	4.33	.19	.92	3.28	.27	+.09	+.85	+3.86	−.29	+.76	+3.77	+4.14	+3.41	+1.05	+4.06	−3.09	−.08	−2.36	+.65	+3.01
Michigan	4.33	3.49	7.65	2.76	2.75	3.99	1.91	+.81	+.34	+2.42	−4.16	−.50	+1.58	+4.89	+4.90	+3.66	+5.74	−1.23	+.85	−1.24	+.84	+2.08
Minnesota	2.42	2.64	1.49	2.53	4.04	2.12	2.69	−.22	+.30	−.27	+1.15	+.52	−.05	−1.04	−2.55	−.63	−1.20	+.41	−.16	+1.92	+1.35	−.57
Mississippi	.67	.41	.31	.12	2.00	1.66	1.59	+.23	−.99	−.92	+.13	−1.22	−1.15	+.19	−1.69	−1.35	−1.28	−1.54	−1.47	+.34	+.41	+.07
Missouri	2.62	4.09	2.44	1.08	3.26	2.87	2.33	−1.47	−.25	+.29	+1.65	+1.22	+1.76	+1.36	−.82	−.43	+.11	−1.79	−1.25	+.39	+.93	+.54
Montana	.53	.24	.27	1.50	.99	.43	4.91	+.29	+.10	−4.38	−.03	−.10	−4.67	−1.23	−.72	−.16	−4.64	+1.07	−3.41	+.56	−3.02	−4.48
Nebraska	.91	1.03	.48	.10	2.76	1.00	2.57	−.09	−.06	−1.63	+.55	+.03	−1.54	+.38	−2.28	−.52	−2.09	−.90	−2.47	+1.76	+.19	−1.57
Nevada	.15	.04	.04	.82	.15	.08	3.69	+.11	+.07	−3.51	0	−.04	−3.65	−.78	−.11	−.04	−3.65	+.74	−2.87	+.07	−3.54	−3.61
New Hampshire	.41	.12	.42	.03	.29	.37	.30	+.32	+.07	+.11	−.30	−.25	−.18	+.39	+.13	+.05	+.12	−.34	−.27	−.08	−.01	+.07
New Jersey	3.76	1.95	6.03	.72	1.15	3.16	.25	+1.81	+.60	+3.51	−4.08	−1.21	+1.70	+5.31	+4.88	+2.87	+5.78	−2.44	+.47	−2.01	+.90	+2.91
New Mexico	.30	.12	.04	1.66	.59	.40	4.08	+.18	−.10	−3.78	+.08	−.28	−3.96	−1.62	−.55	−.36	−4.04	+1.26	−2.42	+.19	−3.49	−3.68
New York	13.27	26.25	12.56	1.86	3.85	10.24	1.61	−12.98	+3.03	+11.66	+13.69	+16.01	+24.61	+10.70	+8.71	+2.32	+10.95	−8.38	+.25	−6.39	+2.24	+8.63
North Corolina	1.51	1.50	2.50	.44	3.22	2.71	1.65	+.01	−1.20	−.14	−1.00	−1.21	−.15	+2.06	−.72	−.21	+.85	−2.27	−1.21	+.51	+1.57	+1.06
North Dakota	.37	.31	.08	.06	1.35	.49	2.35	+.06	−.12	−1.98	+.23	−.18	−2.04	+.02	−1.27	−.41	−2.27	−.43	−2.29	+.86	−1.00	−1.86
Ohio	5.81	4.76	8.07	2.84	3.95	5.25	1.38	+1.05	+.56	+4.43	−3.31	−.49	+3.38	+5.23	+4.12	+2.82	+6.69	−2.41	+1.46	−1.30	+2.57	+3.87
Oklahoma	1.22	.84	.55	5.61	2.21	1.78	2.33	+.38	−.56	−1.11	+.29	−.94	−1.49	−5.06	−1.66	−1.23	−1.78	+3.83	+3.28	+.43	−.12	−.55
Oregon	1.05	.80	.64	.21	1.26	.83	3.24	+.25	+.22	−2.19	+.16	−.03	−2.44	+.43	−.62	−.19	−2.60	−.62	−3.03	+.43	−1.98	−2.41
Pennsylvania	7.45	6.06	9.63	12.65	3.34	7.52	1.51	+1.39	−.07	+5.94	−3.57	−1.46	+4.55	−3.02	+6.29	+2.11	+8.12	+5.13	+11.14	−4.18	+1.83	+6.01
Rhode Island	.65	.43	.91	.02	.12	.54	.01	+.22	+.11	+.64	−.48	−.11	+.39	+.89	+.79	+.37	+.87	−.52	−.02	−.42	+.08	+.50
South Carolina	.79	.51	.70	.13	1.48	1.41	1.03	+.25	−.65	−.24	−.16	−.90	−.49	+.57	−.78	−.71	−.33	−1.31	−.90	+.04	+.45	+.41
South Dakota	.40	.24	.14	.59	1.28	.49	2.57	+.16	−.09	−2.17	+.10	−.25	−2.33	−.45	−1.14	−.35	−2.43	+.10	−1.98	+.79	−1.29	−2.08
Tennessee	1.44	1.52	1.28	.95	1.85	2.22	1.41	−.08	−.78	+.03	+.24	−.70	+.11	+.33	−.57	−.94	−.13	−1.27	−.46	−.37	+.44	+.81
Texas	4.29	3.69	2.69	16.67	5.98	4.87	8.86	+.60	−.58	−4.57	+1.00	−1.18	−5.17	−13.98	−3.29	−2.18	−6.17	+11.80	+7.81	+1.11	−2.88	−3.99
Utah	.41	.35	.29	1.91	.53	.42	2.77	+.06	−.01	−2.36	+.06	−.07	−2.42	−1.62	−.24	−.13	−2.48	+1.49	−.86	+.11	−2.24	−2.35
Vermont	.29	.10	.18	.17	.51	.27	.31	+.19	+.02	−.02	−.08	−.17	−.21	+.01	−.33	−.09	−.13	−.10	−.14	+.24	+.20	−.04
Virginia	1.19	1.11	1.74	1.04	1.82	2.03	1.34	+.35	−.51	+.15	−.60	−.89	−.20	+.70	−.08	−.29	+.40	−.99	−.30	−.21	+.48	+.69
Washington	1.59	1.39	1.12	.75	1.76	1.32	2.25	+.20	+.27	−.66	+.27	+.07	−.86	+.37	−.64	−.20	−1.13	−.57	−1.50	+.44	−.49	−.93
West Virginia	.96	.51	.78	6.55	.75	1.45	.81	+.45	−.49	+.15	−.27	−.94	−.30	−5.77	+.03	−.67	−.03	+5.10	+5.71	−.70	−.06	+.64
Wisconsin	2.53	1.49	2.82	.30	3.36	2.38	1.84	+1.04	+.15	+.69	−1.33	−.89	−.35	+2.52	−.54	+.41	+.98	−2.08	−1.54	+.98	+1.52	+.54
Wyoming	.24	.07	.08	.94	.56	.19	3.27	+.17	+.05	−3.03	−.01	−.12	−3.20	−.86	−.48	−.11	−3.19	+.75	−2.33	+.37	−2.71	−3.08
United States total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Coefficient of geographic linkage (percent)[3]	...	...	...	...	...	...	...	82.78	88.89	53.65	75.34	76.44	46.62	47.39	60.81	79.26	42.32	55.70	55.98	77.74	68.59	57.87

Sources: Value of agricultural production based on preliminary data on gross farm income (excluding government payments) from the United States Department of Agriculture, Bureau of Agricultural Economics mimeographed release, dated May 26, 1941; value of minerals from *Minerals Yearbook, Review of 1940*, p. 18; all other items from the Bureau of the Census.

[1] No data. Percentage is negligible.

[2] Area is 0.002 percent of the total.

[3] Sum of positive differences subtracted from 100 percent.

TABLE 2.—*Degree of similarity of distribution among States of sales, production, population, and land area, 1939*

[Value data used, except for population and area]

Items compared [1]	Coefficient of geographic linkage [2] (percent)	Rank in similarity of distribution
Retail sales and population	88.9	1
Wholesale sales and retail sales	82.8	2
Manufactures and population	79.3	3
Population and agriculture	77.7	4
Wholesale sales and population	76.4	5
Manufactures and wholesale sales	75.3	6
Agriculture and area	68.6	7
Manufactures and agriculture	60.8	8
Population and area	57.9	9
Minerals and area	56.0	10
Minerals and population	55.7	11
Retail sales and area	53.6	12
Manufactures and minerals	47.4	13
Wholesale sales and area	46.6	14
Manufactures and area	42.3	15

Source: Data in table 1.

[1] Item with the more concentrated distribution listed first.

[2] A coefficient of 100 percent indicates complete agreement in the distributions, and zero, complete disagreement. Calculation of the first coefficient (88.9), for example, is as follows: Retail sales and population among States are each expressed as a percentage of the national total; differences in the percentages for each State are calculated, and the sum of the positive differences is subtracted from 100 percent.

of manufactures and area. The array is significant, showing as it does a close correlation of consumer markets with population at the one extreme and at the other extreme a geographic concentration of manufacturing greater than that of population, retail sales, wholesale sales, agricultural production, or value of mine output. In other words, the forces of concentration are stronger for manufacturing than for any other factor. Wholesale sales, however, show almost as much concentration as manufacturing, and retail sales somewhat less than wholesale sales. On the other hand, wholesaling is more closely associated geographically with retailing than with manufacturing. Going back a step farther in the marketing sequence, it is interesting to note that the distribution by States of the value of manufactures corresponds much more to that of the value of agricultural production than to that of the value of mineral production, but in both cases the degree of agreement is relatively low, and some of the production, notably of fruits, vegetables, dairy products, poultry, coal, and stone, is not always used in manufactures.

Certain limitations on these measures of geographic linkage affect interpretations of industrial location. In the first place, the measures do not reflect cause and effect, but merely similarity of location by States. The location of two industries in the same State may be due to: (1) direct linkage, (2) attraction by a common or related factor, or (3) coincidence without causal connection. Generally, the degree of geographic relationship is a more trustworthy interpretation of the measures than linkage or lack of linkage, since it is seldom possible to attribute geographic association solely to a single tie-up of two industries, and, on the other hand, common causes are almost always present, although their influence may be very remote. Retail markets, for example, exert at least some locational pull on industries that specialize in capital goods. Second, the measures depend on whether the elements compared are within or without given States. It makes no difference whatever in the coefficient whether industries, or other factors being compared, are in neighboring States (the locations in fact may be at adjoining sites) or in States 2,000 miles apart. Fortunately, State data will usually catch a significant share of the associated locations. Third, State boundaries are not logical economic boundaries for the study of location. This deficiency may seriously mar the measurements in the compact industrial areas which straddle State lines. Of the 96 metropolitan districts defined by the Bureau of the Census of 1930, 23 were interstate, and among these were the three largest districts, New York, Chicago, and Philadelphia.[8] Fourth, value data are used in this comparison for all economic items, that is, all the items for land area and population. Locational connections may be determined more by such factors as weight, bulk, or perishability, than by the value of the product. Although transportation rate structures are partly adjusted to the value of products, the correspondence is extremely rough. In general, rates decrease less proportionately than weight or bulk per unit of value increases. Consequently, heavy or large space-using commodities influence location more than the value data reflect. This difference is canceled to some extent by the increased outlays for handling and packaging usually required for high-value commodities. Fifth, a comparison of broad items such as population, area, total value of manufactures, and total value of retail and of wholesale sales, gives only an over-all view and lacks the detail necessary for critical analysis of causation. Food retailing is usually restricted to a market of exceptionally short radius, whereas retail markets for furniture or expensive style goods may cover wide areas, especially where a major center offers strong attractions. The wholesaling of consumers' goods undoubtedly would be located closer to retailing and consuming populations than wholesaling of producers' goods. Location of agricultural production close to urban centers is encouraged by local demands for fresh products, such as dairy products, eggs, poultry, fruit, and vegetables, which may have little, if any, relationship to or effect on manufacturing. The distribution of the value of mineral output is substantially affected by petroleum, natural gas, or coal in Texas, Pennsylvania, California, West Virginia, Oklahoma, Illinois, and Louisiana. The transportability and extent of in-

[8] National Resources Committee, *Our Cities—Their Role in the National Economy*, Washington, D. C., 1937, map facing p. 66.

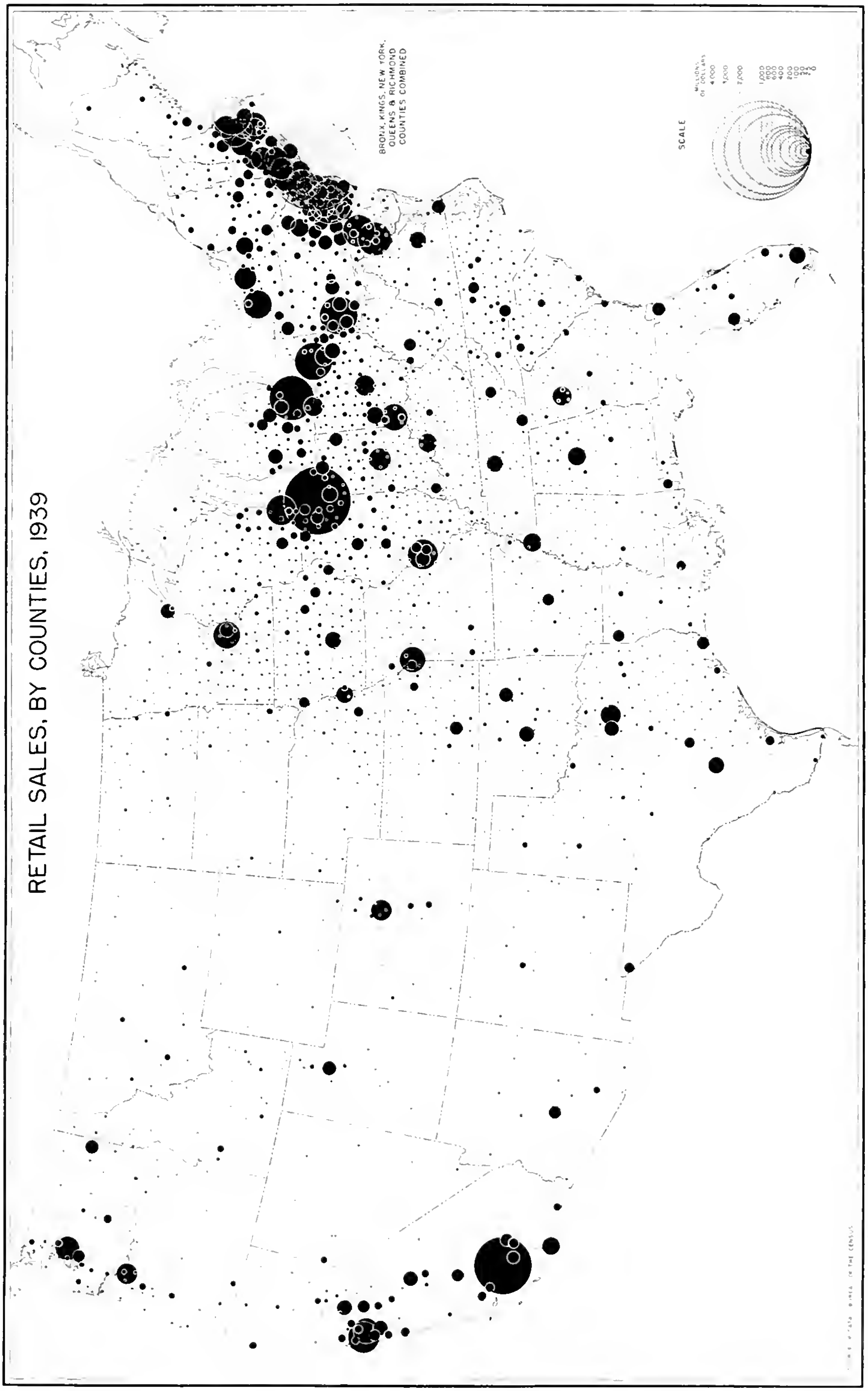

RETAIL SALES, BY COUNTIES, 1939
BRONX, KINGS, NEW YORK, QUEENS & RICHMOND COUNTIES COMBINED
SCALE

FIGURE 82

dustrial use of these fuels shows wide variability not only among the types but also within the types, depending on the shipping medium available.

An attempt to weigh these qualifications fully in this chapter would go beyond the scope of a general survey of markets as a factor in location. Because of the manifold relationships involved among location factors, these special aspects are not exclusively associated with markets. They have, therefore, been considered extensively in conjunction with resources, materials, transportation, and other major forces in location. The more important direct influences of markets and marketing will now be considered.

Tendencies in Marketing

Markets are influential in location of industry through their relationship to the physical requirements of commodity distribution and to the organization for meeting those requirements. When town markets and public auctions were relatively more important than they are at the present time, production patterns showed a marked orientation about those markets. With the early development of the factory system, itinerant traders, general stores, and wholesale concerns became the chief marketing agencies.

Notable recent tendencies of the economy have been the stratification of markets and the fixing of prices by administrative action.[9] The quantity of commodities supplied or demanded is subject to a larger measure of administrative control. This change reflects partly a shift from an agricultural economy in which output depends much on the vicissitudes of nature to an industrial economy in which tempting opportunities for control are presented.

The shifting and reallocation of joint or overhead costs may yield most unusual price and market patterns. Blanketing of prices is commonly used as a device for extending the market of a single establishment over a wide area. Extreme examples of this policy are found in the drug, cosmetic, jewelry, grocery specialty, and chewing gum industries in which the product of one or two plants may be sold nationally at a uniform price. These commodities are all of high value in relation to bulk or weight, but less striking examples exist among the lower-value commodities. Under a system of blanket prices, a plant may even sacrifice most of its home market for more distant markets, as has been true of certain establishments in the rubber-tire industry.

Data are not available to show the flow of commodities among small economic areas, but those based on a State classification are to some extent indicative of the magnitude of interarea trade. A tabulation showing surpluses and deficiencies by States for certain manufacturers in 1929 is presented in table 3. It should be observed that the industries are those having more than 1,000 establishments, and represent largely consumers' goods industries. The table, therefore, does not give a cross-section of all manufacturing. On the average the States—rather large geographic units for this purpose—showed a consumption of 60 percent of their own manufacture for the industries represented. There were no industries among the group of 36 in which more than 50 percent of the manufacture was in the so-called self-sufficient States (those with production less than 20 percent in excess of consumption and consumption less than 20 percent in excess of production). For the industries which produced more than 120 percent of the amount consumed in the home State, the surplus was considerable, being usually more than one-half of the output. On the other hand, the ratio of production to consumption in deficiency States was usually less than one-half. In other words, this group of manufacturing industries with a large number of establishments required considerable interstate marketing. Undoubtedly much more striking surpluses and deficiencies would have been shown by areas smaller than States, by a larger representation of producers' goods industries, and by industries with less than 1,000 establishments.

From the standpoint of geographic gradation of prices, the most nearly perfect distribution of markets is found in the case of a few basic agricultural products. The price patterns for corn, for example, show a strikingly uniform gradation from areas of surplus to areas of deficiency (fig. 84).[10] The lowest average prices received by farmers for corn have been in the area around the junction point of the Dakotas and Minnesota, at the northwestern extreme of the corn-producing area; the highest average prices occurred in Arizona and southeastern Nevada. Both the volume of production relative to consumption and the cost of transporting the products to the markets are determining factors in the regional variation of these prices. The lowest prices are not at the point of maximum surplus but at that point within an area of surplus production where transportation costs to the market are the greatest. The highest prices exist where there is an excess, however small, of consumption over production at a point farthest away from the area of surplus production.

[9] For a discussion of inflexible administered prices, see Gardiner C. Means, *Industrial Prices and Their Relative Inflexibility*, Senate Document No. 13, 74th Cong., 1st sess., January 17, 1935.

[10] Map adapted from A. R. Gans and R. F. Hale, *Regional Variations in Prices Received by Farmers*, 1925–34 (processed), United States Department of Agriculture, Washington, D. C., May 1939, p. 4.

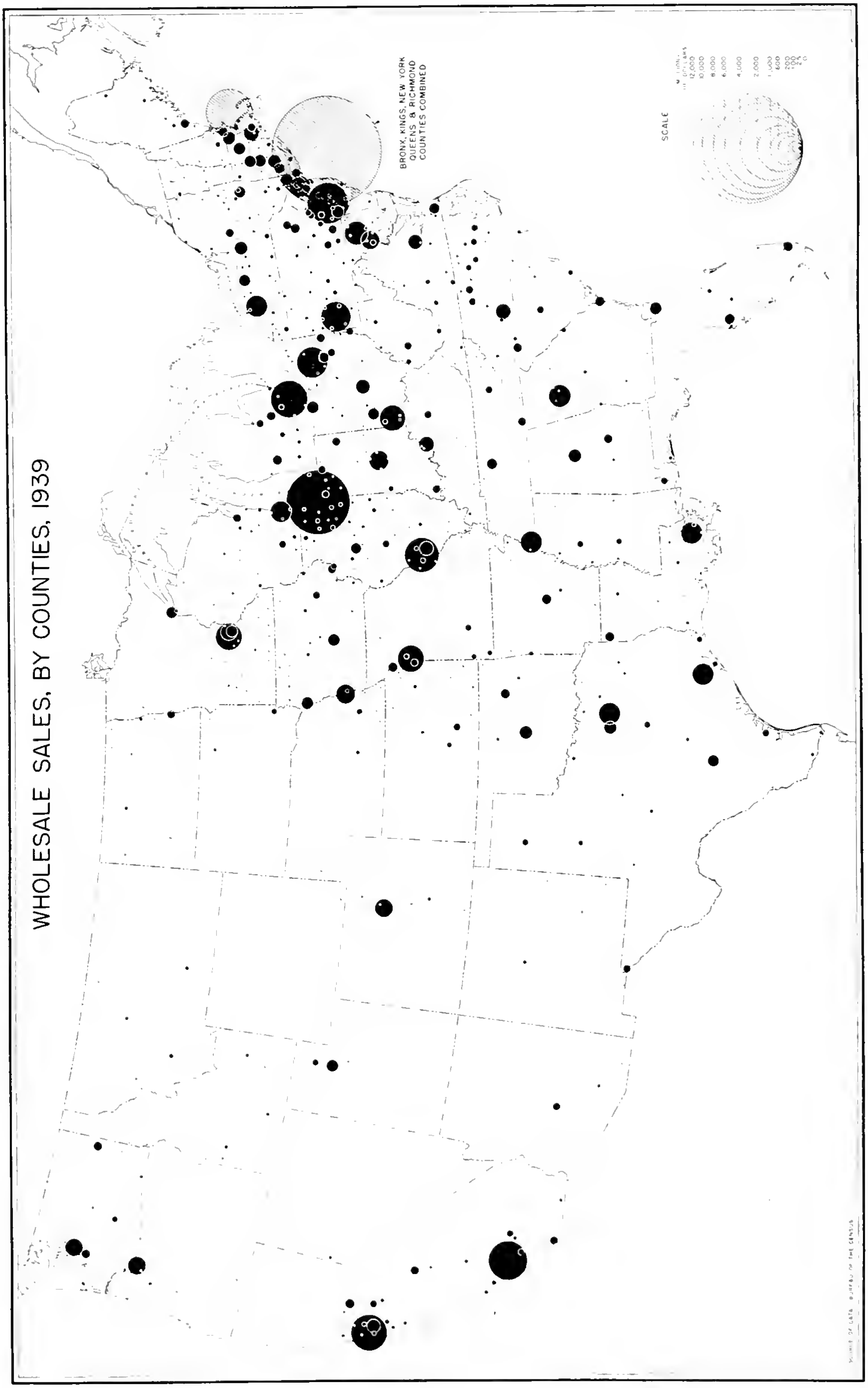

WHOLESALE SALES, BY COUNTIES, 1939
BRONX, KINGS, NEW YORK QUEENS & RICHMOND COUNTIES COMBINED
SCALE

Figure 83

TABLE 3.—*Surpluses and deficiencies of manufacturing production, United States, 1929*

[Manufacturing industries with more than 1,000 establishments]

Industry	Number of establishments	Production—value added by manufacture (millions of dollars)	Percentage of total production in— Surplus States	Self-sufficient States	Deficiency States	Consumption as percent of output in surplus States	Production as percent of consumption in deficiency States	"Regional" consumption as percent of total[1]
1. Concrete products	2,438	59	32	49	19	56	58	86
2. Ice cream	3,150	172	39	45	16	78	53	86
3. Planing mills	4,849	258	37	50	13	62	48	86
4. Bakery products	20,785	789	40	42	18	60	83	84
5. Beverages	5,154	167	57	28	15	35	56	80
6. Ice	4,110	171	47	42	11	56	34	80
7. Railroad repair shops	1,851	669	43	33	24	51	48	79
8. Newspapers and magazines	11,524	1,347	48	28	24	54	52	78
9. Foundries and machine shops	8,605	1,753	66	25	9	61	26	73
10. Furniture	3,778	522	59	25	16	51	36	71
11. Structural steel	1,482	232	68	7	25	57	46	71
12. Boxes	1,249	134	61	21	18	51	38	70
13. Meat packing	1,277	461	52	12	36	40	54	69
14. Pottery	1,749	213	59	17	24	46	43	68
15. Confectionery	2,021	178	69	14	17	54	35	68
16. Book, music, and job printing	12,712	740	54	18	28	41	47	68
17. Paint	1,063	235	72	12	16	53	32	66
18. Stonework	1,881	135	61	12	27	36	44	65
19. Canning and preserving	2,997	288	49	24	27	25	17	63
20. Butter	3,527	111	57	19	24	33	18	62
21. Flour milling	4,022	180	41	44	9	15	23	60
22. Electrical machinery	1,802	1,329	78	13	9	45	17	57
23. Bookbinding	1,108	72	66	14	20	33	31	56
24. Men's clothing	3,691	461	74	17	9	38	16	54
25. Knit goods	1,888	443	79	8	13	39	21	52
26. Shoes	1,341	451	74	15	11	30	17	48
27. Automobile parts	1,154	681	73	11	16	26	23	46
28. Wood products	12,915	854	79	10	11	27	16	42
29. Millinery	1,293	98	84		16	29	21	40
30. Jewelry	1,536	98	81		19	23	23	38
31. Women's clothing	8,082	775	76	1	23	14	26	35
32. Silk goods	1,491	319	85	12	3	24	4	35
33. Spinning and weaving	1,281	626	79	1	20	15	23	33
34. Fur goods	2,855	101	79	9	12	14	15	32
35. Cigars and cigarettes	1,636	710	82	8	10	9	12	25
36. Turpentine	1,183	26	96		4	8	4	11

Source: August Lösch, *Die raumliche Ordnung der Wirtschaft* (Jena, 1940), table 16, p. 240. Manufacturing data from U. S. *Census of Manufactures, 1929*. Consumption estimates based on States' shares in total national income. States with production 20 percent or more in excess of consumption, classed as "surplus"; those with consumption 20 percent or more in excess of production, classed as "deficiency"; all others classed as "self-sufficient."

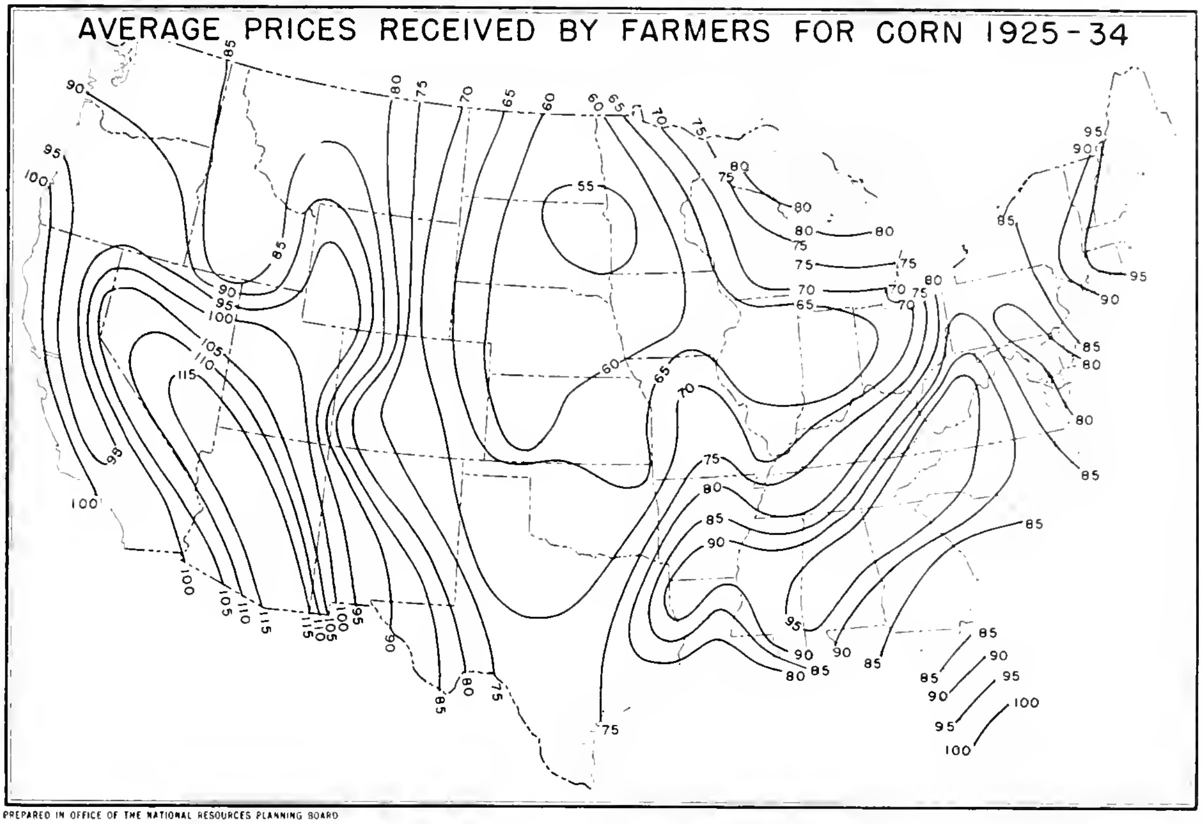
[1] Production of self-sufficient and deficiency States plus consumption of surplus States, as percentage of total production.

These differentials in prices affect not only the location of agricultural production but also the location of manufacturing. Low prices for livestock in a given area, for example, are favorable to the location of packing plants to supply local needs. Markets for fresh milk in the populous sections of the country largely crowd out manufacture of butter, cheese, and condensed milk to areas where lower milk prices prevail. In general, the industries that are most likely to remain are those in which transportation and other marketing costs are low with respect to the regional differential in the prices of the materials. This relationship, however, is a necessary but not a sufficient condition for location in an area with a surplus of materials. Before manufacturing industries using these materials will develop, there must be some consumption of the products locally, or costs of shipping the products to other areas must be favorable. Thus, the location of butter production in Minnesota, an area too far away to ship fresh milk to the eastern markets, is determined by (1) the existence of a surplus of milk; (2) the transportation cost to the farthest area of delivery that may influence regional price differentials; (3) the magnitude of the local market for butter; (4) the extent to which competition in markets for butter in outside areas can be met; and (5) alternative uses for milk that hold in check the use for butter production.

An even better adjustment of supply and demand than that in the market for corn is found in the larger securities markets for issues that are actively traded. In this case, however, the transportation factor is negligible, since only the rights and not the physical properties are transferred. The securities, moreover, are completely standardized for any one issue. Both transportability to locations desired by the purchaser and standardization are prerequisites for the exact adjustment of supply-demand relationships. The bulky commodities offered on an inspection basis are very seldom sold in well-organized central markets. Even the prices of such commodities as wheat, hogs, eggs, and cotton are influenced considerably by qualitative factors, with the result that it is difficult to make geographic comparisons. But much has been done toward standardization. Fruits and vegetables, formerly sold entirely to local buyers on personal inspection, are now sold over wide areas on the basis of grades.

Illustrative of the modification of geographic price variations arising from a market factor are the prices received by farmers for wool (figure 85).[11] Although

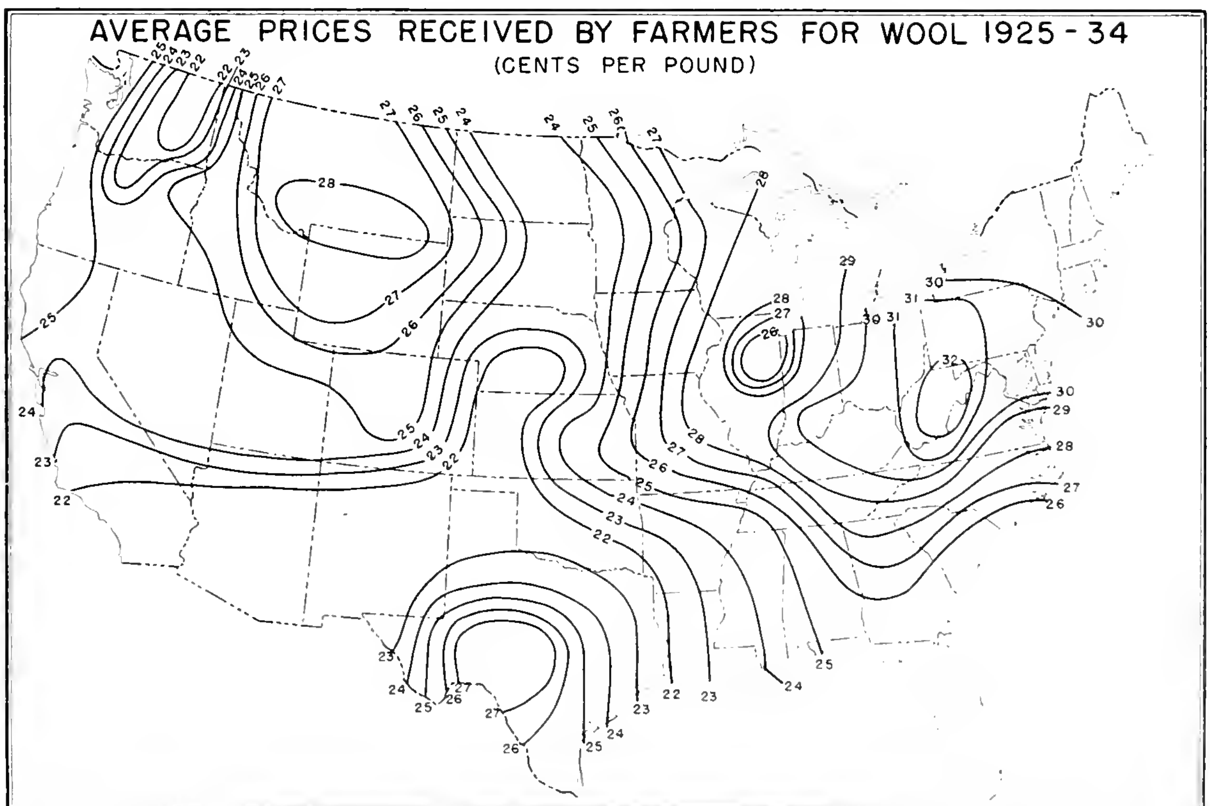
[11] Adapted from Gans and Hale, *op. cit.*, p. 12.



PREPARED IN OFFICE OF THE NATIONAL RESOURCES PLANNING BOARD

FIGURE 84

UNIT: Cents per bushel



PREPARED IN OFFICE OF THE NATIONAL RESOURCES PLANNING BOARD

FIGURE 85

these prices are affected by quality, staple length, and shrinkage, there is a rather gradual increase from areas of surplus to areas of deficiency. In analyzing these variations, the effect of imports should be kept in mind; the United States does not produce enough wool to meet domestic demands. Quite apparent is the scaling down of prices close to the Chicago market for sheep despite the small quantities of wool produced in the local agricultural area.

A central market offers attractions to buyers and sellers by reducing market risks. Farmers may ignore local markets in favor of centralized markets in order to be assured of stable prices. More exact information on commodities, on the other hand, can be a force for decentralization, a change which for some agricultural commodities has been taking place since 1920.[12] Among the reasons for this decentralization are (1) improved quality of commodities; (2) standardization and grading; (3) better market information for judging local prices; (4) transportation changes, especially increase in the use of trucks and passenger automobiles, and improvement of highways; and (5) certain production economies, especially in poultry and meat packing.

Decentralization of markets for agricultural commodities has not always been attended by decentralization of manufacturing. Buyers in the field have been used increasingly by large manufacturers for such commodities as livestock and tobacco, where strict standards governing purchase can be established. Farmers used to bring the products to urban centers, whereas it has now become increasingly feasible to do the assembling in the field by truck. Field buyers have been used chiefly by large centralized plants to compete with the decentralized plants.

Standardization of products and improvement of markets have had numerous other effects on the location of industry. The time consumed in marketing is a factor. Local town markets absorbed large amounts of time for the volume of business transacted. Decentralized industry was practically a necessary accompaniment, whereas large-volume exchange of commodities and large-scale industry are undoubtedly facilitated by purchase and sale on a specification basis. Improvement of market information and establishment of grades has reduced the need for concentrating goods in central markets for physical inspection. Large establishments can send out representatives to make purchases in scattered areas and still meet the standards required for mass production. Large establishments have assisted, in many instances, in the grading of commodities so that suitable supplies could be obtained. The net effect of grading appears to have been encouragement of centralized manufacturing.

[12] Geofrey S. Shepherd, *Agricultural Price Analysis*, Iowa State College Press, Ames, 1941, p. 16.

Flow of Goods to Markets

Although industry produces largely for ultimate consumers, it should not be assumed that most of the output is directed immediately toward that end. The flow of goods in 1929 is shown in figure 86. Width of the bands in the figure is proportional to the dollar volume of business and increases somewhat between stages to allow for transportation costs. The data measure only the flow of movable tangible commodities and do not cover transactions in real estate, construction, finance, insurance, light and power, and other commercial, professional, and personal services. Despite the change in the dollar volume of business since 1929, the proportions are no doubt roughly applicable at the present time. Consequently, attention will be drawn to the proportions rather than to the absolute volumes.

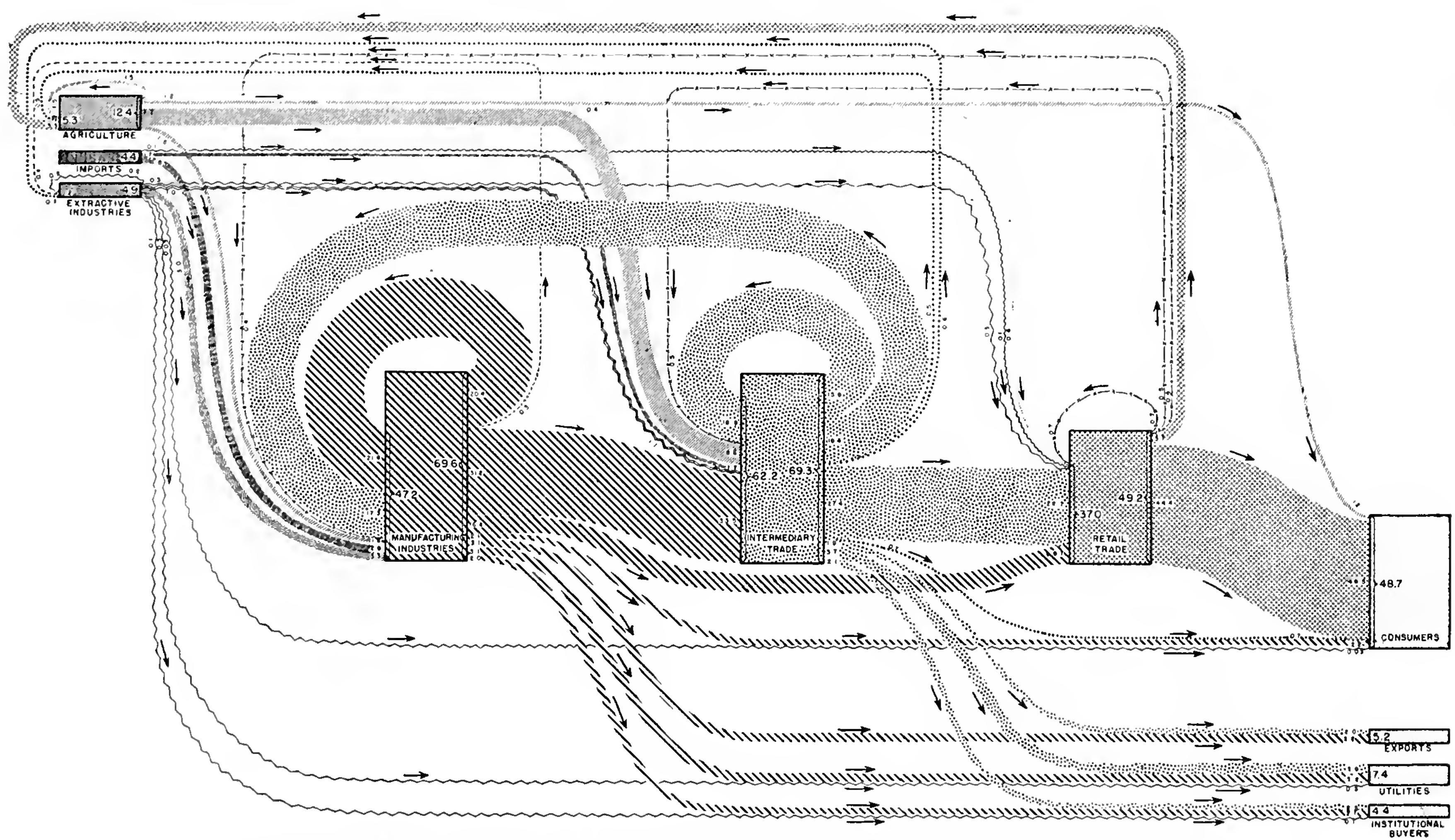
Between resources and consumers are several "whirlpools" in the flow of goods. Products obtained from mining, forestry, fishing, and imports go in large part to manufacturing; products of farms and factories, to intermediary trade, retail trade and ultimate consumers. Substantial portions of the products of each stage either bypass certain of the later stages, continue their flow within the same stage, or recirculate to earlier stages. Such bypassing occurs on a considerable scale in the flow of agricultural products directly to wholesalers or consumers; in the sale of manufactured products directly to retailers, consumers, public utilities, institutional buyers, or exporters; and in the sale of wholesale goods to public utilities, institutional buyers, or exporters. Of course, the most important bypassing sales quantitatively are those from the farm to intermediate trade and from manufacturing industries to retail trade. Sales of agricultural products directly to retailers account for only a little more than 3 percent of the total flow of goods from agriculture.

The chief flows of goods within a given stage are those for agriculture, manufacturing, and intermediary trade, and the chief flows to earlier stages, those from intermediary trade to manufacturing and from retail trade to agriculture. The volume circulating wholly within manufacturing, from intermediary trade back to manufacturing, and wholly within intermediary trade is greater in the aggregate than the volume going to ultimate consumers.

The largest flows of goods in terms of value away from any of the stages are those from manufacturing

THE FLOW OF GOODS IN THE UNITED STATES

(FIGURES IN BILLIONS OF DOLLARS)



SOURCE: Paul W. Stewart and J. Frederic Dewhurst, *Does Distribution Cost Too Much?*, Twentieth Century Fund, New York, 1939, master chart.

FIGURE 86

and from intermediary trade.[13] These two volumes are about equal. The flows from retail trade to all destinations and also from all sources to ultimate consumers are likewise approximately equal, but each is only slightly more than two-thirds the flow away from either manufacturing or intermediary trade. Agriculture, other domestic extractive industries, and imports combined supply less than one-third as much dollar volume as manufacturing and intermediary trade and less than one-half as much as retail trade.

Within each stage, except the final one, there are subgroups of distribution. Many mines are "captive", or industrial-consumer owned, mines which produce mostly or entirely for certain plants. In agriculture, on the other hand, most of the production is by independently operated farms; consequently, the production is not closely tied to specific consumers.

Manufacturing products are distributed through several primary channels. About one-fourth goes to industrial and other large users; a little less than one-fourth to wholesalers and jobbers; one-fifth to wholesale branches operated by the manufacturers; slightly more than one-sixth to retailers of all types including chain stores; and one-twelfth to other plants in the same organization (table 4). Distribution from factories directly to household consumers and from factories to factory-operated retail stores amounts in each case to less than two percent of the total manufacturers' sales. Industrial consumers and wholesalers are for the most part concentrated in the urban areas with large populations; retail trade is more nearly distributed in accord with total population. The common interposition of wholesaling between manufacturing and retailing makes the locational connection of manufacturing with population less direct.

Wholesale, or intermediary trade, is divided into various types of operation (table 5). The most important group consists of the wholesale merchants who usually carry stock and trade with a multiplicity of buyers and sellers. Their location is not often determined either by a few sources of supply or a few customers.

The diversity of connections of manufacturers facilitates centralized as well as specialized production. One of the chief functions of wholesale trade is specialization in marketing so that producers are able to avail themselves of a complex pattern of consumer demand. Wholesale trade, as defined by the census, includes distribution of goods to factories as well as away from them. Assemblers, for example, are engaged primarily in bringing together farm products in large quantities from scattered sources. Convergence of products toward sizeable plant units at local points is therefore facilitated. The bulk of materials handled in assembly is relatively much larger than the dollar volume of sales indicates, because the materials are handled before much value has been added. In

[13] Note that total values, unlike values added, cumulate from stage to stage.

TABLE 4.—*Distribution of manufacturers' sales, by primary channels, 1939*

Channel	Net sales (thousands of dollars)	Percent of United States total
All channels	54, 685, 816	100.0
Total distributed sales	50, 649, 117	92.6
To industrial and other large users	13, 887, 129	25.4
To wholesalers and jobbers	12, 896, 935	23.6
To own wholesale branches	10, 639, 816	19.5
To retailers of all types (including chain stores)	9, 812, 679	17.9
Export, direct to buyers in other countries	1, 142, 377	2.1
To own retail stores	984, 216	1.8
To household consumers	826, 862	1.5
To export intermediaries	459, 103	.8
Interplant transfers	4, 036, 699	7.4

SOURCE: Bureau of the Census, *Distribution of Manufacturers' Sales: 1939*, preliminary report, January 12, 1942, p. 4.

TABLE 5.—*Wholesale sales in United States, by type of operation, 1939*

Type of operation	Sales (thousands of dollars)	Percent of United States total
All types	55, 265, 640	100.00
Service and limited-function wholesalers	23, 641, 924	42.78
Wholesale merchants	18, 688, 897	33.82
Voluntary group wholesalers	753, 586	1.36
Converters (textile)	425, 167	.77
Export merchants	778, 001	1.41
Importers	1, 379, 575	2.50
Industrial distributors	729, 650	1.32
Cash-and-carry wholesalers	108, 902	.20
Drop shippers or desk jobbers	474, 891	.86
Wagon distributors	80, 259	.14
Retailer—cooperative warehouses	222, 996	.40
Manufacturers' sales branches (with stocks)	8, 846, 940	16.01
Manufacturers' sales offices (without stocks)	4, 679, 262	8.47
Petroleum bulk stations and terminals [1]	3, 807, 908	6.89
Independent bulk stations	627, 674	1.13
Commission stations	1, 080, 479	1.96
Salary stations	1, 739, 676	3.15
Cooperative bulk stations	37, 962	.07
Distributing terminals	322, 117	.58
Agents and brokers	11, 201, 035	20.27
Auction companies	434, 283	.79
Brokers (merchandise)	3, 390, 695	6.14
Commission merchants	2, 748, 072	4.97
Export agents	571, 449	1.03
Import agents	343, 105	.62
Manufacturers' agents (with stocks)	252, 056	.46
Manufacturers' agents (without stocks)	1, 144, 961	2.07
Selling agents	1, 741, 777	3.15
Other agents	574, 637	1.04
Assemblers (mainly farm products)	3, 088, 571	5.58
Assemblers of farm products	792, 159	1.43
Commission buyers	121, 704	.22
Cooperative marketing associations	611, 029	1.10
Cooperative sales agencies	578, 939	1.05
Cream stations	48, 564	.08
Country grain elevators: independent	271, 154	.49
Country grain elevators: line	226, 917	.41
Country grain elevators: cooperative	196, 430	.36
Packers and shippers	241, 675	.44

SOURCE: Bureau of the Census, *Wholesale Trade: 1939, United States Summary*, processed release dated March 31, 1941, p. 4.

[1] Sales include taxes.

the main, intermediate trade performs a dispersive rather than a concentrating function, and facilitates centralized production.

In the retail-store channels, independent stores handled 74.7 percent of the total sales volume, according to the Census of 1939, and independent single-store units handled 65.2 percent of the total (table 6).[14] These independent stores purchase mainly from wholesale concerns, although the volume purchased directly from the factory, usually through agents, is considerable. In this latter case, the factory may have to maintain a large distribution organization to perform most of the functions of wholesalers. Chain stores have a greater buying power than independents; consequently, closer contact with large manufacturing plants can be maintained. Not infrequently these stores will even control or operate factories themselves. In 1939, chains reported sales amounting to 21.7 percent of the total for all retail stores. Sales through retail types other than independent stores and chains were only 3.6 percent of the total. It is noteworthy that mail-order houses accounted for only 1.3 percent of total sales; market and roadside stands for 0.3 percent; state liquor stores for 0.6 percent; and house-to-house sales for only 0.4 percent.

TABLE 6.—*Retail sales in United States, by type of operation, 1939*

Type of operation	Sales (thousands of dollars)	Percent of United States total
All types	42,041,790	100.0
Independents	31,409,859	74.7
Single store	27,417,200	65.2
Multiunit	3,752,509	8.9
Market and roadside stands	103,162	.3
Leased departments—independent	136,988	.3
Chains	9,105,825	21.7
Local chains	1,581,386	3.8
Sectional or national chains	6,771,009	16.1
Manufacturer-controlled chains	583,062	1.4
Leased-department chains	170,368	.4
Other types	1,526,106	3.6
Utility-operated stores	151,539	.4
Direct selling (house to house)	153,397	.4
Commissaries or company stores	148,248	.3
Farmer and consumer cooperatives	224,375	.5
State liquor stores	249,430	.6
Mail-order houses	537,413	1.3
Other types of operation	61,704	.1

SOURCE: Bureau of the Census, *Retail Trade: 1939, Types of Operation*, p. 5.

Concentration and Dispersion of Product

In the marketing process, commodities are brought together or dispersed depending on the location of the source materials and on that of each type of handling, manufacture, or use. Each stage in the flow of commodities provides the markets for the preceding stage, usually in differing areas. The geographic patterns will be noted before passing to a consideration of how the location of industry is influenced by the impact of marketing activity. Agriculture is, with few exceptions, an extensive source of products. There was on April 1, 1940, a total of 6,097,000 farms distributed over an area of about one billion acres in the United States,[15] and most of these provided products which were marketed through convergent channels to manufacturing plants. Sources of forest products are more concentrated than those of agricultural products. The Pacific Northwest and the Southern States together supply three-fourths of the annual saw timber cut,[16] whereas the consumption is distributed over the entire country somewhat in the order of population.

Fishing, a third important source of products, is widely distributed along the coastal and Great Lakes areas and employs a considerable number of operating units. In 1939, California supplied 21 percent of the value of the catch in the United States (excluding Alaska), and Massachusetts 17 percent; no other State supplied as much as eight percent.[17] The total number of fishing vessels was 4,423. In addition a total of 64,000 small boats, about half of them motor powered, were used. On-shore fishing also supplied considerable quantities. A large part of the catch is delivered directly to fish canneries, of which there were only 214 in 1939,[18] to central fish markets, and to fertilizer establishments. It appears that the primary marketing of fish, at least to canneries and fertilizer establishments, is more convergent than dispersive.

Marketing characteristics of mineral products vary widely among types of minerals. As a general rule, the manufacturing use of minerals, at least in the early stages, is markedly concentrated, but some of the sources also are concentrated. For example, in 1939 there were only 209 iron mines (excluding some small unreported mines),[19] but there were 81 blast furnace establishments and 253 steel works and rolling mills.[20] Forty-eight mines, located largely in northeastern Minnesota and northern Wisconsin, produced 83 percent of the total iron ore in 1939, whereas 104, or about one-half of the total number, produced only 1 percent of the total.[21] Some iron ore is obtained from foreign sources, but this also comes from a few mines. Very likely the sources of iron ore are more concentrated than the blast furnace industry in which the minimum-

[14] Two-store and three-store operations are classified by the census as multi-unit independents.

[15] Data from the census of 1940.

[16] Based on data of the Forest Service, U. S. Department of Agriculture.

[17] From data in Fish and Wildlife Service, United States Department of the Interior, *Fisheries of the United States and Alaska, 1939, Summary of Catch by Sections* (processed).

[18] *Census of Manufactures, 1939, Summary for the United States*, processed release dated December 29, 1940, p. 3.

[19] *Minerals Yearbook, Review of 1940*, p. 529.

[20] *Census of Manufactures, op. cit.*, pp. 2 and 12.

[21] Computed from *Minerals Yearbook, 1940, Review of 1939*, p. 536.

sized unit is comparatively large. Mineral industries in which there are ordinarily less than 100 mines or quarries each in the entire country are those for abrasive stones, asbestos, asphalt, barite, bauxite, feldspar, fluorspar, fuller's earth, glass sand, gypsum, magnesite, manganese, marble, mercury, mica, phosphate rock, potash, pumice, salt, silica, sulphur, talc, soapstone, and tripoli.[22] In all of these activities combined there were in 1935 less than 800 mines or quarries. Industries reporting 100 or more, but less than 600, mines or quarries each include anthracite, basalt, clay, copper, granite, iron ore, lead and zinc, molding sand, sandstone, and slate. Notable exceptions to this decided concentration are limestone, with about 1,900 producers; sand and gravel, with 2,100 producers; bituminous coal, with 6,000 mines (excluding truck mines having an annual output of less than 1,000 tons each); natural gas with 54,000 producing wells (many of which may be clustered in a small area); and crude petroleum, with 380,000 producing wells.[23] Primary marketing of petroleum from producing wells is conspicuously a concentration process. In 1939 there were only 485 petroleum refining establishments.[24] Fifty-seven refineries in California, the Texas-Louisiana coast, eastern Pennsylvania, and northern New Jersey accounted for one-half of the total capacity on January 1, 1941.[25] Thus, the production of many wells is required to supply a typical refinery unit. Natural gas is also assembled in large volume in most areas before it is transported to the point of final use. Gas is unusual among materials in that its collection and distribution are handled, with minor exception, as a continuous process requiring an extraordinary degree of coordination to assure continuous flow. Certain large industrial uses of natural gas, particularly carbon black and electric power generation, may call for concentration from the gas wells to the consuming unit, but for the vast residential market for gas the production of many wells is brought together merely for convenience in transportation, since the consuming units far outnumber the producing wells. Marketing of bituminous coal is also partly convergent and partly divergent. Large consumers, such as coke plants, railroads, and electric power plants, individually may use larger quantities than are produced by individual mines. On the other hand, the several thousand mines supply coal to millions of consumers either directly or through middlemen. But even where coal is sold through wholesale channels, a single mine is usually capable of supplying more than one outlet.

To summarize, the pattern of marketing for raw materials is almost universally one of convergence for agricultural products and petroleum, mainly one of convergence for fishing, and one of mixed convergence and divergence for forest products, bituminous coal, and natural gas. For most nonfuel minerals the sources of supply and the primary markets are concentrated.

Manufacturing establishments in 1939 numbered 184,000.[26] Within this number there is considerable concentration of activity among a small proportion of the plants. In wholesaling in the same year there were 201,000 establishments,[27] with probably less concentration relatively than in manufacturing, whereas in retailing the number of establishments (stores in this case) mounted to 1,770,000,[28] with no doubt less proportionate concentration than in wholesaling. Goods sold to ultimate consumers, of course, have on the average an exceedingly dispersed market. If the family is taken as the buying unit, there are about 35 million outlets for consumers' goods. This number of units far exceeds that of any other segment of the marketing process, although the 6 million farms that supply raw materials constitute a considerable fraction. A nonagrarian economy using large quantities of nonagricultural materials will doubtless show more geographic concentration of industry and fewer business establishments relatively than an agrarian economy. Mixed agrarian and nonagrarian economies complicate the problem of markets and location. The forces of concentration in such an economy disturb the decentralization of industry with respect to the multiplicity of farm and ultimate consuming units that would obtain in an agrarian economy. A decidedly nonagrarian economy which imports a large proportion of the necessary raw materials might have a relatively simple market and location pattern.

Relation of Markets to Production

Marketing organizations may exist because they are able to assemble the products of many firms; because they may have special information which enables them to bring together numerous buyers and sellers; or because certain functions, such as sorting, inspecting, grading, or standardization, may be performed best at a central point. The ability of the organization to serve one producer is frequently contingent on obtaining the business of other producers. If certain of the

[22] *Statistical Abstract*, 1940, pp. 760–761. It is recognized that the size and location of the operating units vary markedly, but the number of units is so small as to indicate geographic concentration.

[23] Data on mineral industries in *Minerals Yearbook, Review of 1940* and *Statistical Abstract, 1940.*

[24] *Census of Manufactures, op. cit.*, p. 10.

[25] Bureau of Mines, *Information Circular*, I. C. 7161, April 1941.

[26] *Census of Manufactures, op. cit.*, p. 1.

[27] Bureau of the Census, *Wholesale Trade: 1939, United States Summary*, processed release dated March 31, 1941, p. 2.

[28] Bureau of the Census, *Retail Trade: 1939, Types of Operations*, p. 1.

producers become large enough to do their marketing without the services of intermediaries, the remaining business may become too small to justify the existence of a marketing concern. Thus, other producers who are dependent on the marketing agency for contact with the market will lose their outlets unless they are able to find alternative channels. A readjustment cannot always be made to compensate for this loss. At one time automobiles were sold mainly by farm-implement, carriage, and machinery dealers. Large sales of automobiles were not indispensable for dealers with diversified lines. When sales of certain producers expanded, the specialized automobile agency developed as a means for offering more service or lower prices; the makes of cars not sold in considerably larger volume than they had been previously were soon eliminated. The shift to larger units of production and distribution was accelerated by the increasing technical requirements for repair of automobiles, a trend that continued after the shift to special agencies was largely completed and that led to still further concentration. Granted that this change in marketing may not have caused manufacturing plants to transfer bodily from one location to another, it has been influential in determining which plants have survived and certainly has favored locations advantageous to large-scale production.

Relation of Buying and Selling Units

The location of an industrial establishment may be influenced not only by the economics of size but by the number and location of its customers.[29] Where there are one or more suppliers selling mainly to a single establishment, the former escape the necessity of maintaining a multiplicity of market contacts. They may, in consequence, enjoy a corresponding freedom of location, unless the buying establishment desires to maintain close contact with its suppliers, even at some sacrifice of supply costs. In this event, the location of the suppliers will be governed by the location of the buyer. Similarly, when a seller supplies many buyers, the former may find it advantageous to locate near its customers, even though it might have produced somewhat more cheaply elsewhere.[30]

The foregoing conditions assume that the suppliers sell directly to the users of their product, but physical contiguity may be of little importance if the two can be satisfactorily brought together through an intermediate market organization. In such case, the producers may be scattered or centralized as seems desirable. The very existence of an intermediary marketing organization may sometimes constitute the main factor making it possible for producers to centralize and to gain the advantages which centralization may offer. Occasionally, however, as in the production of certain foodstuffs, a manufacturer may set up his own national distribution system, instead of marketing his product through independent distributors, in order to be able to centralize production.

The use of intermediary marketing systems may be obviated by vertical integration, which may result either in bringing together plants concerned with the successive processes in one location, or in the wider dispersion of these plants. The former result is likely to be attained when the complementary processes are located in nearby areas. If the complementary producers to be brought under unified control are very large, however, unification may promote wider separation. Illustrations of this may be found in the processing of certain materials, notably sugar, copper, petroleum, and tin, where large domestic concerns control large raw-material producing properties in foreign lands. Without this control, the distant raw-material sources would probably be exploited on a smaller scale, if at all. Possibly a larger amount of the materials would be directed to local industry; that is, the incentive for a colonial-type economy would be weaker, and more consideration would be given to the development of local industry rather than to an economy based on export of raw materials and import of finished products. The importation of capital combined with absentee control may, however, produce greater aggregate internal growth of industry than would have occurred without them. Thus, it appears that independent marketing organizations exercise the greatest influence on location, on the one hand, where relationships are not so close as to induce vertical integration of producing units, and, on the other hand, where risks are not so great that they can be undertaken only by a concern having full control of distribution.

The trend in recent years appears to be away from independent middlemen.[31] More of the intermediary distribution of goods is being handled by manufacturers, retailers, and even consumers, either directly or through agencies owned or controlled by them. This assumption of marketing functions does not necessarily indicate their elimination, although it appears to be connected with reduction of costs.[32] The growth of multi-unit retailing, which facilitates centralized buying, has no doubt led to a decrease in intermediary functions.

[29] This holds true even where the delivery of goods involves merely bookkeeping transfers.

[30] The customers must, of course, be sufficiently clustered to make close contact possible.

[31] Stewart and Dewhurst, *op. cit.*, p. 345.

[32] *Ibid.*

Moreover, standardization of products at manufacturing plants has decreased the need for inspection, sorting, and grading by independent marketing agencies.

Separation of the marketing function from production is fostered by the need for the assembly of products from numerous relatively small producers, as is the case with most farm products. This assembly is certain to influence the location of the processing industries; a well-developed system of assembly would facilitate concentration. Another important factor is the combination of materials to be brought together. A poultry-packing plant, for example, may not use dairy products, but in the work of assembly there may be economies in collecting both poultry and dairy products. The development of transportation has promoted this type of marketing by increasing the economies of delivery to a single collection point.

In the distribution of products to consumers, the purchaser almost always has smaller-scale needs than the seller. Marketing from factory directly to ultimate consumer is comparatively unimportant. Most manufactured products are brought together with other products in retail establishments for the consumers' convenience or to permit comparison.

It is not uncommon for the flow of goods to be channeled both to and from manufacturing concerns by the same marketing agency. Tire dealers may purchase old rubber to be sent to manufacturing establishments. By accepting in trade worn-out or demolished cars, automobile agencies incidentally act as collectors and marketers of scrap materials. Numerous household articles, such as radios, electric irons, vacuum sweepers, and washing machines, are sold on a trade-in basis. The articles received in trade may be resold to the local trade without alteration, or they may be reconditioned before being sold. This reconditioning may be done in local independent repair shops, in which case it would have a definite dispersive effect, or it may be done in a factory belonging to the original producer. Although in the latter instance, the work would usually be more centralized than if it were done by independent establishments, it would nevertheless tend to be more dispersed than the manufacture of the original product. Where there are advantages in having the reconditioning done by the original manufacturer, a compromise location would be sought; that is, one convenient for both functions. Frequently, trade-in products are taken off the market to prevent them from competing with the sale of new products. This practice is especially common where strong preferences for brands lead the same general group of purchasers to compete for the old as well as for the new products. The elimination of second-hand products from the market promotes greater production of new commodities by an individual producer and thereby increases the relative importance of his location. The method of disposal of the used product is also of locational significance. If it is sent back to the factory, the used product may in some plants constitute so important a part of the total supply of materials as to influence directly the location of the plant. This is unlikely, however, where there are economies of large-scale production which can be linked to a concentrated source of materials. A large copper-wire producer, for example, would not collect scraps of wire from all parts of the country if he could easily obtain a sufficient supply of virgin copper from copper mines.

In some instances, scattered secondary sources of materials cannot exercise an important influence on the location of the manufacture of the ultimate product because the manufacturer of the latter may not be equipped to process certain of the primary products to be derived from the traded-in article. For example, radio manufacturers not producing their own wire would be unable to reconvert the wire received in old radios. Under such circumstances, secondary recovery products, instead of being delivered directly to the manufacturer of the final product, are channeled to various stages of industry. Because consumable goods are made, as a rule, from not one but many materials, their reconversion usually tends to have a dispersive effect on industry. This explains, for example, the wide dispersion which exists in some branches of the steel industry and in many metal industries. Numerous small steel plants, forging shops, foundries, and machine shops depend on scrap metals. The aggressiveness of local enterprise in utilizing these local materials will be a factor in the dispersion of industry. Trade practices, competitive relationships, and public policy toward industry also play a part.

Initiative in Purchase and Sale

A substantial factor in location is the source of initiative in exchange. The marketing system is a complex of numerous initiating impulses. In major degree, consumers set in motion the ultimate sale of goods, for it is typical that they must exhibit interest before their wants become known, whereas a merchant is continually ready to sell within the limits of his capacity. Consumers are, of course, susceptible to influence and persuasion. A decision to consider purchase of a commodity may result from advertising displays and publicity. Even the location of the concern is a factor in the choice of goods. A typical retail store attempts by its location to take advantage of the latent purchasing inclination of an area. The location that may yield the maximum net return, of

course, may not be the lowest-cost site. Because consumers find it convenient to have retail stores close at hand, the latter are usually small units adapted to serve small areas. A concern that attempts to sell over a wide area usually will have to send salesmen or agents to make the contacts that a local establishment is able to make more directly by reason of its location, or it will have to contact prospects through periodicals, leaflets, or catalogs. In this instance, considerable aggressiveness is likely to be displayed by the seller. In fact, the barrage of "literature" sent out by numerous direct-by-mail sellers may be the only means for maintaining a central location and wide distribution of the product.

Where the occasion for exchange of commodities is determined more by the initiative of the purchaser than by that of the seller, the structure of industry is built up in response to what are believed to be the marketing possibilities. When production becomes too large to maintain a price structure considered acceptable to the producers, output is reduced. On the other hand, when intensity of demand increases, production is expanded within the limits of capacity, and, if prospects of sustained demand are considered sufficiently bright, capacity also is expanded.

Monopolistic marketing practices are not required to render selling less active than purchasing as a stimulant of the exchange of goods. Collusive pricing, or even tacit understandings on prices, may result in restrictions of volume, although the decreases may be countered more or less by sales effort (nonprice competition). These restrictions are more influential on the character and location of the later stages than of the early stages of production, for prices of finished goods are generally less flexible than those of raw materials, and particularly of the agricultural output of thousands of independent producing units. But even in agriculture, control measures have been attempted with varying degrees of success.

A restriction of national output may not necessarily involve curtailment of production in a particular region. The regional impact depends on the extent of the restriction and repercussions on prices and purchasing power. It has long been known that large crops may bring in a smaller gross return than relatively small crops, and there are circumstances in which a similar result might obtain for nonagricultural commodities.[33] But smaller output of the portion of commodities sold in exchange to other areas would usually result in a reduction of total regional output even though the reduced supply of outgoing commodities would create larger purchasing power in monetary units. The primary reason is that outside markets are so important and the proportion of consumption of local commodities so small in most areas that regional competitive gains would be outweighed by losses (cf. table 3). A larger importation of commodities from other areas might, of course, result, but this would not necessarily lead to a larger total volume of local production. The industrial importance of an area would best be promoted by more direct stimulation of output.

Division of Markets

Although maximum net return is a motivating impulse of enterprise, the conditions under which this return is sought will lead to differences in sales policies. Competition requires a division of the market horizontally with consequently reduced average volume for each business concern unless such competition increases the total volume sufficiently to compensate. Limitation of the extent of distribution within any one market area means that larger-scale producing operations will depend on widening the distribution of the product. This spreading may proceed by the introduction of new establishments in new areas, or expansion of operations in the home area and absorption of freight for shipment to outside areas.[34] The extent of freight absorption feasible will depend markedly on the volume of business in the home market which, for each concern, depends partly on the volume going to competitors.

Increasing division of the market will usually foster dispersion of industry, not only because plants within the area will not, as a rule, locate on adjacent sites, but also because ability to supply a wider area from a single source will be limited by (1) less possibility of attracting a minimum volume to warrant an attempt to sell in outlying portions of the area, (2) differences among concerns in the sales effort in the home area, and (3) differences among concerns in the ratio of fixed costs to total costs.

Monopoly, on the other hand, means that a concern gets all of whatever volume of business is available in an area and at prices within its control. If the advantages of large-scale production are not extraordinarily large, its prices are likely to be higher than those of a competitive division of the market, but probably not so much higher that its business is reduced to less than it would be were there substantial competitors. These characteristics encourage expansion of sales over a wider area for a given plant. Widening of the market area in turn almost certainly

[33] In technical language, when the elasticity of demand is less than unity.

[34] Assuming, of course, that increases in transportation cost with distance make absorption necessary to compensate for smaller increases in prices in such areas.

leads to readjustment of prices in the home market. Although such readjustment might check the geographic spread of the market for a single plant, the possibilities are that it would encourage further spread.

A reasonable deduction is that a trend toward reduction of the number of units competing in the market will tend to centralize producing operations rather than merely to change the control of an equal number of plants. In observations of these changes in industry, it is difficult to isolate this one causal relationship. The tendency is so strong, however, that the conclusion appears well founded.

Summary

Markets have a more indirect influence than production factors on the location of industry. Although marketing activity is itself a segment of industry to consider in industrial location, the chief influences are the more intangible effects on the location of manufacturing. Marketing connects not only production with final consumption, but also the various types of productive processes at differing locations.

The problem of bringing buyers and sellers together to achieve an exchange of goods is certain to have repercussions on the location of industries with respect to each other and to final consumers, and on the scale of industry in any area. Large-scale establishments and concentrations of industry are made possible by development of the marketing system to permit concentration of materials wherever they must be drawn from scattered sources, and dispersion of products wherever they must be distributed to scattered users.

The primary reasons for the existence of an independent marketing organization are the complexity of the distribution process, the need for assembling commodities from diverse sources of manufacture, and the need for specialized skill in making contacts. These factors are well illustrated by department stores which bring together thousands of items from numerous manufacturing areas and which are especially suited to make consumer contacts, display the products, finance the sales, and provide delivery and servicing.

Development of marketing organization facilitates the growth of specialization and of complex location patterns in manufacturing. It enables distribution of products to branch out into various channels and for greater distances. Thus, it promotes that type of manufacturing which depends on gathering commodities from or dispersing them to scattered areas. Without extensive marketing, production would be tied closely to resources and would be confined to simple combinations of materials locally available. Greater distance of production from resources does not necessarily mean closer association of industry with markets. In fact, it may mean production at greater average distance from markets because of (1) the wider separation of resources and markets, and (2) the attraction of nonmarket factors, such as the supply of power, labor, and capital.

Only a small percentage of producing industries are consumer-market oriented. These industries are predominantly consumers' goods industries requiring speed of delivery or close contact. Typical examples are photoengraving, newspaper publication, and the production of ice, ice cream, beverages, compressed gases, and machine-shop products. Other industries, such as production of manufactured gas and service parts may be intermediate-market oriented. Here again, speed of delivery and close contact usually exercise a controlling influence. The location of the great majority of producing industries is influenced more largely by the sources of materials and other production factors than by the geographical distribution of markets.

CHAPTER 11. LABOR

By Francis M. Boddy*

Distribution and Character of Labor Force

The labor force, unlike other production requirements, is distributed geographically in rough proportion to the population and therefore in much the same manner as the ultimate consumer markets. Because of this fact, what appears to be a labor-oriented [1] industry may actually be market-oriented, and vice versa. Most of the industries that are distributed widely throughout the population are, in fact, likely to be market-oriented.

The geographic distribution of the population is being continually changed by differing rates of national increase and by the actual movement of people from one area to another. Although broad shifts in the population and the consequent shifts in the location of the labor force are relatively slow, particular sections of the labor force and of the population have a high degree of geographic mobility. As a result of this mobility particular areas may show a rapid growth or decline in the available labor force. This element of impermanence in the locational pattern of labor resources has its effect on the location of those industries for which labor is a prime locational factor, but the mobility of labor which is widened by such shifts frees, to a large extent, such industries from the necessity of locating at the present sources of labor, allowing them the possibility of locating in an area which has other advantages and inducing the necessary labor force to migrate to the chosen location.

A further characteristic of the labor force is the adaptability of the worker to a wide range of occupations and tasks. While some skills and abilities are highly specialized, the bulk of the labor force can be rather readily transferred from one type of work to another, although some retraining may be involved. Even the highly specialized worker is adaptable to some new occupations, and may retain the benefit of a good part of his skill even when transferred to quite different occupations. This intraindustry mobility and adaptability gives a further element of locational freedom even to an industry that is dependent on sources of relatively skilled labor.

Labor, like the other factors of production, is not a homogeneous group of identical individuals but contains persons differing greatly in education, skill, and efficiency. These differences lead to differences in rates of remuneration, but these are also geographic differences in the wage-rates of individuals performing the same tasks. These differences may be the reflection of differences in living costs, in the nonmonetary advantages of residence in particular areas, or of differences in bargaining power arising out of differing alternative opportunities or out of varying degrees of organization. Because of these factors, and because of inertia, lack of information, and other frictions, the mobility of the labor force is not sufficient to lead to geographical equality of earnings.

Although the pattern of industrial location may be presumed to adjust itself in time to the geographic differences in labor and other production costs and to market characteristics, there are serious lags and frictions which may make this adjustment to more economic locations a slow and halting process. Sunk costs are an anchoring element that may prevent even major differences in labor costs from leading to a transfer of operations to the better location. Many plants are rebuilt and improved only a piece at a time and this may lead to a persistence in the poorer locations. If the industry is expanding and new plants are being constructed, these new plants may be expected to be located at the optimum locations, but the older plants will continue to produce as long as the immobile production factors return any rent to their owners.

A further brake on the long-run adjustments to economic locational forces may be a lack of effective competition within the industry. Competitive striving for advantage would, in time, eliminate the plants at inefficient locations and encourage growth at the best locations, but monopolistic conditions may suppress the economic signals and penalties of poor location.

Of the major industrial groupings, the manufacturing industry is in an intermediate position. At one extreme, agriculture, mining, petroleum production, and similar industries are strongly oriented to natural resources, while at the other extreme, public utilities, personal service, retail trade, and similar industries are oriented to the markets.

The location of manufacturing plants is determined in most cases by a compromise or balance of the locational pulls of the market and of the sources of the productive resources used. In this compromise, the

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[1] A labor-oriented industry is one in which the availability of labor at alternative locations and geographic differences in labor cost and labor efficiency are the primary locational determinants.

strength of the pull toward sources of labor will be affected by the relative importance of labor costs, geographical differences in labor costs, the relative mobility of labor, and the degree of substitution possible between labor and the other productive resources.

Importance of Labor Costs

An index of the relative importance of labor costs to total costs can be computed from the data of the Census of Manufactures by calculating the ratio of wages and salaries to total value of products. While the value of product figure is not identical to total cost of production, this ratio is a good index of the ratio of labor cost to total cost. The ratios of wages and salaries to the value of products, calculated for each of the 20 industry groups from the data of the Census of Manufactures for 1939 and 1937 are given in table 1, together with other ratios calculated from data taken from the same source.

The five industry groups with lowest values of the ratio of wages and salaries to the value of products in both 1939 and 1937 were tobacco manufactures,[2] products of petroleum and coal, food and kindred products, chemicals and allied products, and nonferrous metals and their products. There is some tendency for the industries in these groups to be oriented to raw-material sources, but little apparent orientation towards labor supplies. Of the 10 industry groups with the middle range of values of this ratio, a few show a tendency to locate near sources of the raw materials used, the rest reveal no clear-cut locational pattern, as industry groups.

The five industry groups with the highest values of this ratio in both 1939 and 1937 were transportation equipment (except automobiles), lumber and timber basic products, printing and publishing and allied industries, machinery (except electrical), and miscellaneous industries. Some of the industries in these groups, particularly those in the lumber and timber group, are oriented towards raw materials, but a good many of them show a tendency to locate in populous areas, indicating an orientation to labor sources or markets.

But even in these five groups the ratio of wages and salaries to the value of products is relatively low, indicating that in most industries other individual items of cost are likely to equal or exceed labor costs. In view of this fact, labor costs are unlikely to be a primary determinant of location unless geographic variations in unit labor costs are large in relation to variations in the cost of other factors.

The ratios of wages and salaries to value added by manufacture give an indication of the relative importance of these costs to the other major internal costs, mainly plant costs, and overhead expenses. The industry groups with the highest values of these ratios again show no general tendency to be oriented on labor supplies, but some appear to have a tendency to locate near raw-material sources, others to locate near the markets.

The ratio of salaries to wages is included to show the rather wide variation in the relative importance of salaried workers and wage earners in the various in-

[2] The low labor-cost ratio for this industry group is to some extent misleading, for internal-revenue taxes make up a large share of value added by manufacture and the value of products. Even if corrected for this factor, the labor-cost ratio would be quite low.

TABLE 1.—*Selected cost relationships in United States manufacturing 1939 and 1937, by industrial groups*

Census industry group	Ratio of wages and salaries: To value of products (percent)		Ratio of wages and salaries: To value added (percent)		Ratio of value added to value of products (percent)		Ratio of salaries to wages (percent)	
	1939	1937	1939	1937	1939	1937	1939	1937
1. Food and kindred products	11.1	11.2	32.8	37.5	33.8	29.8	28.7	28.9
2. Tobacco manufactures	6.0	6.5	22.8	25.3	26.5	25.5	16.6	17.2
3. Textile mill products and other fiber manufacturing	27.0	27.3	58.1	62.7	46.4	43.6	16.6	14.7
4. Apparel and other finished products made from fabrics	24.9	23.4	59.6	58.9	41.7	39.7	20.1	22.0
5. Lumber and timber basic products	32.3	34.3	58.6	62.0	55.1	55.3	16.7	15.8
6. Furniture and allied products	27.4	28.4	55.5	58.9	49.4	48.3	26.7	25.3
7. Paper and allied products	19.6	19.0	45.4	45.7	43.1	41.6	27.4	27.2
8. Printing and publishing and allied industries	32.0	36.9	46.7	53.3	68.5	69.3	67.2	79.4
9. Chemicals and allied products	14.0	14.7	27.7	30.8	50.3	47.8	46.4	45.0
10. Products of petroleum and coal	7.5	7.6	32.8	37.4	22.9	20.4	27.7	24.5
11. Rubber products	22.8	24.5	50.7	58.7	45.0	41.8	27.5	26.3
12. Leather and leather products	25.2	24.6	59.9	62.0	42.0	39.6	18.8	17.6
13. Stone, clay, and glass products	28.4	30.2	44.8	48.4	63.3	62.3	23.9	21.1
14. Iron and steel and their products, except machinery	24.4	26.1	54.5	57.3	44.8	45.6	32.6	29.9
15. Nonferrous metals and products	15.0	15.4	46.7	50.6	32.1	30.4	28.8	27.3
16. Electrical machinery	27.6	29.5	47.6	50.8	57.9	58.0	41.6	37.1
17. Machinery, except electrical	30.9	32.0	51.1	53.6	60.5	59.7	34.5	30.7
18. Automobiles and equipment	18.9	17.5	57.6	58.5	32.8	29.9	17.8	14.7
19. Other transportation equipment	34.3	32.1	64.2	67.7	53.4	47.4	26.6	23.7
20. Miscellaneous industries	30.1	32.6	50.5	55.3	59.7	58.9	35.7	34.8
All manufacturing industry	20.5	21.2	47.1	51.0	43.5	41.5	28.0	26.9

SOURCE: Calculated from *Census of Manufactures*, preliminary data.

dustry groups. In view of this variation, the sum of wages and salaries is a better figure to use in measuring the relative importance of labor costs, and variations between industries in the importance of labor costs, than the wage figure alone.

These data on broad industry groups, while giving evidence that labor costs do not bulk large in manufacturing in general or in broad groupings of manufacturing industries, cover up wide variations in the relative importance of labor costs among the separate industries. From data of the 1939 Census of Manufactures the ratio of wages and salaries to the value of products can be computed for each of 446 separate industries. A frequency distribution of these ratios is given in table 2.

TABLE 2.—*Frequency distribution of 446 manufacturing industries by size of labor-cost ratio, 1939*

Ratio of wages and salaries to value of product (percent)	*Number of industries*
75 to 80	3
70 to 75	6
65 to 70	3
60 to 65	3
55 to 60	5
50 to 55	10
45 to 50	7
40 to 45	21
35 to 40	40
30 to 35	53
25 to 30	82
20 to 25	70
15 to 20	68
10 to 15	40
5 to 10	31
0 to 5	4
	446

SOURCE: *Census of Manufactures*, 1939.

All the 15 industries having ratios of wages and salaries to the value of products, equal to 60 percent or more, were industries using the "contract factory" system. These contract factories do not in most instances purchase the materials worked on, but perform operations on materials owned by others; thus the value of product does not include the bulk of material costs and the ratios of labor cost to total value of product for such industries are not comparable with those for other industries. These contract-factory industries are all in the apparel and textile groups, and their location is determined mainly by the location of the other firms in the trade for whom the contract work is performed.

Of the 15 industries with labor-cost ratios between 50 percent and 60 percent, 7 were industries in which labor costs bulk large, not because of the contract-factory system, but because the products themselves contain a large amount of expensive labor. Included are such industries as photoengraving, machine and hand typesetting, and optical instruments and lenses. The remaining 8 industries in this second group were more industries of the contract-factory type.

Only 7 of the 30 industries with labor-cost ratios above 50 percent employed more than 10,000 wage earners in 1939, and only 2 of these 7 employed more than 25,000 wage earners. Of the 28 industries with labor-cost ratios of 40 to 50 percent, 10 employed more than 10,000 wage earners, and 6 of these employed more than 250,000 wage earners. Forty-four of the 93 industries with labor-cost ratios of 30 to 40 percent employed more than 10,000 wage earners, and of these 44, 17 employed more than 25,000 wage earners.

The largest of these high labor cost industries, in order of the number of wage earners employed in 1939, are listed in table 3, together with the number of salaried employees, the value of the total labor-cost ratio, and the value of the ratio of value added by manufacture to the value of products.

These 25 industries with labor-cost ratios above 30 percent and wage-earner employment of more than 25,000 employed a total of only 1,476,453 wage earners. The 71 industries in the United States with wage-earner employment of above 25,000 employed 5,092,759 wage earners, while all manufacturing industries employed 7,887,242 wage earners. It is clear, therefore, that the bulk of manufacturing employment is in those industries in which labor costs account for less than 30 percent of the value of products.

The listed major industries with labor-cost ratios of above 30 percent should be the industries most affected by factors affecting labor costs in alternative locations, but the extent to which the location of labor resources will control or determine the plant location in these industries is not determined only by the importance of labor cost. The sawmill industry, for example, is oriented towards sources of raw materials and makes use of local labor supplies, drawing in additional workers from other areas if necessary, and moving the labor to new locations as the industry moves to new areas. On the other hand, newspaper printing and publishing is oriented directly to the urban markets and labor resources have been developed in these areas. In both of these industries, in the early days when both were developing into new areas, a large group of very mobile workers was developed which supplied the new plants in new areas where local population was sparse, or lacked the number of skilled workers needed.

Geographical Differences in Labor Costs

Industries such as the machine-shop products and gray-iron and steel castings are essentially service industries to other metal-working industries, and their location is dominated by the advantages of being near the industrial areas they serve. Since the workers in such industries are of the same general types developed by the other industries in the general areas that they

serve, the location of their market and of their labor force tends to correspond, and labor as a distinct location factor exerts no separate force of its own.

A few of the industries, however, serve large areas and even national markets, and for these industries included in table 3, such as the hosiery industries, the office and store machines, tableware, and the aircraft and aircraft parts and engines industries, the high labor-cost ratio would indicate that they might be sensitive to differences in the availability of the necessary labor force, and to differences in labor costs, between different areas. If, as in the aircraft industry, many of the types of labor skills needed are highly specialized and need long training to develop, the industry may find it difficult to develop rapidly in new areas. The time and expense of training inexperienced workers and the cost of the wage rates necessary to move skilled workers from the already developed producing areas both operate to make the industry difficult to locate or relocate in new areas to meet changed market or labor supply conditions. If, on the other hand, the specialized workers needed are but a small part of the total labor requirements, or if the industry can adapt its methods to use relatively unskilled workers for most of the operations, then the existence of large amounts of available labor in other areas, particularly if unit labor costs would be lower, creates both the incentive and the possibility of expanding or moving to new areas.

During periods of recession when labor supplies are plentiful in the older areas the pull toward new locations may not be great, but as all industry expands, industries which can use the labor forces of nonindustrial areas will find stronger incentives to move into the areas of surplus labor resources and lower wage rates. Even in times of depression and with surplus labor force available at the older locations, however, if union policy insists on high wage rates the industries may find it profitable to move to open-shop territories. The desire of employers to escape union pressures of all types, not only those affecting wage rates, may also be a strong incentive toward location in nonunion areas, such as the deep south and smaller towns and rural areas, although in some cases the union organization has been able to organize the workers in the new areas as well, after the industry has moved. The fear of such action may, in some situations, prevent the shift of an industry into new areas which would seem at first glance to be better locations.

Other things being equal, differences in wage rates between areas will influence most of those industries in which the labor-cost ratio is high, which do not need to locate at the site of some natural resource or special market, and which use types of labor that are immediately available in different areas or can be trained readily from the types that are available.

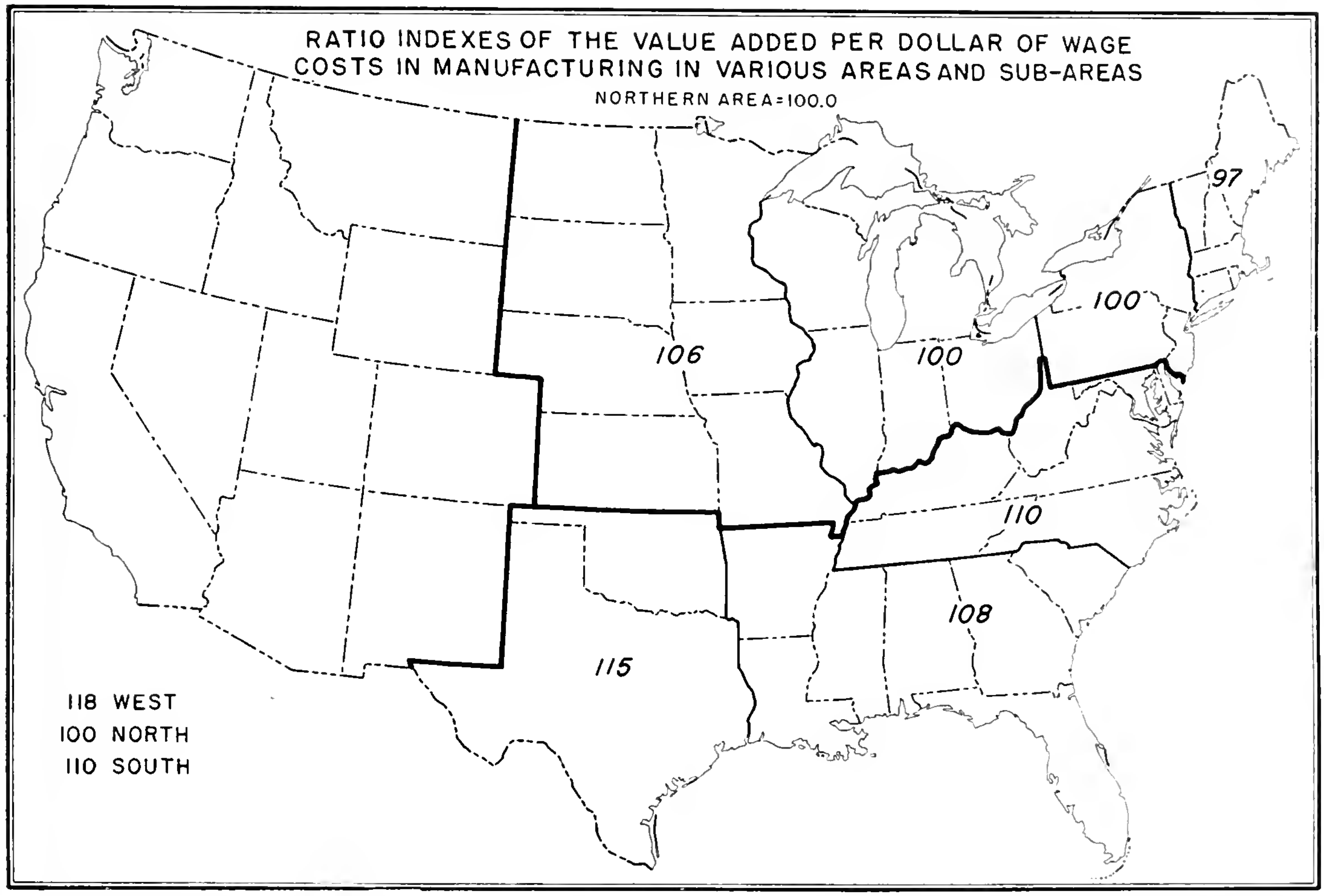
In a study made by A. F. Hinrichs and Arthur F. Beal [3] of geographical differences in hours and wages in 105 manufacturing industries, data are presented in which comparisons of 1937 wage earnings per man-hour are given for 82 industries and divisions of industries between the North and the South.[4] Hourly earnings were higher in the North than in the South in 79 of the 82 industries for which data on both areas were tabulated. The South was above the North in hourly earnings in only 2 industries (glass, and zinc smelting and refining) and had equal hourly earnings in 1 industry (nonferrous metal alloys and products). Data were given on hourly earnings in the North and West for 64 industries. Of these 64, 30 industries had higher hourly earnings in the North, 33 had higher hourly earnings in the West, and 1 industry had equal earnings in the 2 areas.

These figures on wage rates must be somehow corrected for differences in labor efficiency if true labor cost figures are to be derived, that would show the economic advantages of different areas as far as labor costs are concerned. This study by Hinrichs and Beal also reports the average value added by manufacture per man-hour for the three areas and for each industry. These data do not give an accurate measure of labor efficiency, for variations in the products produced by the same industry in different areas may be substantial enough to require different methods of production and different proportions of the productive factors used, and even a standardized product may sometimes be produced by different technical combinations of the productive factors in different areas. However, if the products of an industry are roughly equivalent in the different areas and the technical methods of production much the same, then the value added by manufacture per dollar of wage cost may be used as an index of the competitive labor cost advantage that one area has over another.

Figure 87 presents the over-all picture of the geographic differences in such an index of labor cost advantage for the industries within each area and subarea compared to the same industries in the North main-area. This index was computed by dividing the index of the

[3] "Geographical Differences in Hours and Wages . . ., 1935 and 1937," *Monthly Labor Review*, vol. 50, No. 5. (May 1940.)

[4] North consists of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Michigan, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas. South consists of Delaware, Maryland, District of Columbia, West Virginia, Virginia, North Carolina, Kentucky, Tennessee, South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas. West consists of Montana, Wyoming, Colorado, New Mexico, Idaho, Utah, Nevada, Arizona, Washington, Oregon, and California.



SOURCE: Data from A. F. Hinrichs and Arthur F. Beal, "Geographical Differences in Hours and Wages, 1935 and 1937," *Monthly Labor Review*, May 1940.

FIGURE 87

value added by manufacture per man-hour for each area and subarea by the index of the average wages per man-hour, the result being an index of value added per dollar of wage cost. Since the North indexes were considered 100 percent, the index gives the comparative labor cost advantage of other areas to the North. The indices for each industry were weighted by the relative importance of each industry in the area or subarea under consideration; thus the bias caused by the concentration of low or high wage industries in the North, or in the area being compared with it, was avoided. These summary figures show a 6 to 10 percent advantage in the West North Central, the lower South, and the upper South subareas over the general North area. The Southwest subarea shows a 15 percent advantage over the North, while the West area shows an 18 percent advantage over the North.

These general indexes cover up a wide range of variations among the separate industries, however, so the same ratio of value added per dollar of wage cost was computed for each industry for which data were available for the North and for at least one of the other areas (South or West). These detailed comparisons gave the following results:

1. Of the 82 industries for which North-South comparisons could be made, the North had a labor cost advantage of more than 10 percent over the South in 17 industries, and a labor cost advantage of less than 10 percent in 15 additional industries. The South had a labor cost advantage of 10 percent or more in 32 industries, and an advantage over the North of less than 10 percent in 18 industries.

2. Of the 64 industries for which North-West comparisons could be made, the West had a labor cost advantage of more than 10 percent in 30 industries over the North, and an advantage of less than 10 percent in 12 additional industries. The North had a more than 10 percent advantage over the West in 13 industries, and a less than 10 percent advantage in 9 industries.

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3. To summarize: The South had a labor cost advantage over the North in 50 out of 82 industries, while the West had an advantage over the North in 42 out of 64 industries.

In general, therefore, these data indicate that differentials in hourly wage earnings may not be balanced by differences in labor productivity, and that perhaps the movement or expansion of some industries into the South and West have been influenced by real differences in unit labor costs in favor of those areas. Some industries, on the other hand, may locate in the North because of real labor cost advantages in that area, in spite of the generally higher wage rates. These are not completely reliable indexes, however, for many of the industries do differ to an appreciable extent in the products produced and the technical methods of production used in the various areas. Substantial differences in wage costs, however, may be taken as significant even in industries which are not strictly homogeneous over the country in regard to products and methods.

Of the 25 major industries tabulated in table 3, only 4 are included in the industries covered by this study of geographic wage differences. These 4 industries are: hosiery (full-fashioned and seamless combined), pulp, machine-tool accessories, and machine-shop products. In all these industries the South had a better than 10 percent advantage, in terms of value added per dollar of wage cost, over the North. In the pulp industry, the West has a large labor cost advantage over both North and South.

The following additional industries, employing between 10,000 and 25,000 wage earners in 1939, had labor-cost ratios of over 30.0 percent and are included in the geographical wage rate study: cotton narrow fabrics; silk-throwing—commission; shirts, collars, nightwear—contract factories; cast-iron pipe and fittings; and machinery, not elsewhere classified. The South has a labor cost advantage, as measured by the ratio of value added per dollar of wages, over the North in all these industries and an advantage of over 10 percent in the shirts, collars, and nightwear, and machinery industries.

These industries with high ratios of salaries and wages to the value of products and distinct wage productivity differences should feel a strong locational pull toward the low labor cost areas. The South does have a substantial share of the hosiery, pulp, and cast-iron pipe industries (although in the latter two, natural resources may be the dominant location element), but the other industries have not been drawn into the South to any large extent. In the case of the machine-tool accessories and machine-shop products industries this may be due to their strong linkage to the metal industries in general, and in the case of the three textile and apparel industries, it may be linkage to related industries or orientation towards the markets that has prevented greater development in the South.

TABLE 3.—*Major U. S. manufacturing industries with labor cost ratios of 30.0 percent or more in 1939*

Industry	Number of wage earners	Number of salaried employees	Wages and salaries to value of products (percent)	Value added by manufacturing to value of products (percent)
Sawmills, veneer mills, and cooperage-stock mills, including those combined with logging camps and with planing mills	265, 185	14, 983	35. 4	59. 6
Hosiery, full-fashioned	97, 200	4, 479	40. 6	56. 5
Newspapers, publishing and printing	96, 991	66, 550	34. 7	74. 7
Oeneral commercial (job) printing	96, 039	20, 298	35. 3	62. 7
Household furniture	95, 010	8, 915	31. 8	52. 8
Oenerating, distribution, and industrial apparatus, and apparatus for incorporation in manufactured products, not elsewhere classified	70, 401	21, 354	32. 8	60. 2
Shipbuilding and ship repairing	66, 611	7, 658	38. 1	53. 1
Hosiery, seamless	61, 852	2, 971	34. 7	52. 0
Machine-shop products, not elsewhere classified	60, 717	12, 667	31. 4	60. 7
Gray-iron and semisteel castings	58, 430	5, 839	41. 1	62. 3
Women's and misses' dresses (except house dresses) made in contract factories	49, 742	1, 199	76. 0	94. 9
Aircraft and parts, including aircraft engines	48, 637	13, 771	37. 7	65. 6
Men's and boys' suits, coats, and overcoats (except work clothing) made in contract factories	48, 487	1, 355	75. 2	92. 0
Machine tools	36, 624	8, 220	38. 5	70. 7
Officer and store machines, not elsewhere classified	36, 204	6, 008	42. 5	80. 6
Hardware, not elsewhere classified	35, 645	4, 965	33. 8	60. 7
Communication equipment	32, 119	9, 300	36. 5	74. 7
Mechanical power—transmission equipment	30, 268	4, 732	33. 0	70. 4
Steel castings	30, 088	4, 292	39. 1	66. 6
Brick and hollow structural tile	29, 069	2, 479	40. 8	71. 2
Tableware, pressed or blown glass and glassware, not elsewhere classified	27, 330	2, 880	37. 6	72. 2
Pulp mills	26, 870	2, 379	47. 2	36. 2
Lithographing and photolithographing (including preparation of stones or plates and dry transfers)	26, 000	5, 148	34. 5	62. 6
Bookbinding and related industries	25, 773	3, 936	37. 8	70. 3
Machine-tool and other metal-working machinery accessories, metal-cutting and shaping tools and machinists, precision tools	25, 161	4, 257	43. 3	75. 0
	1, 476, 453	230, 635		

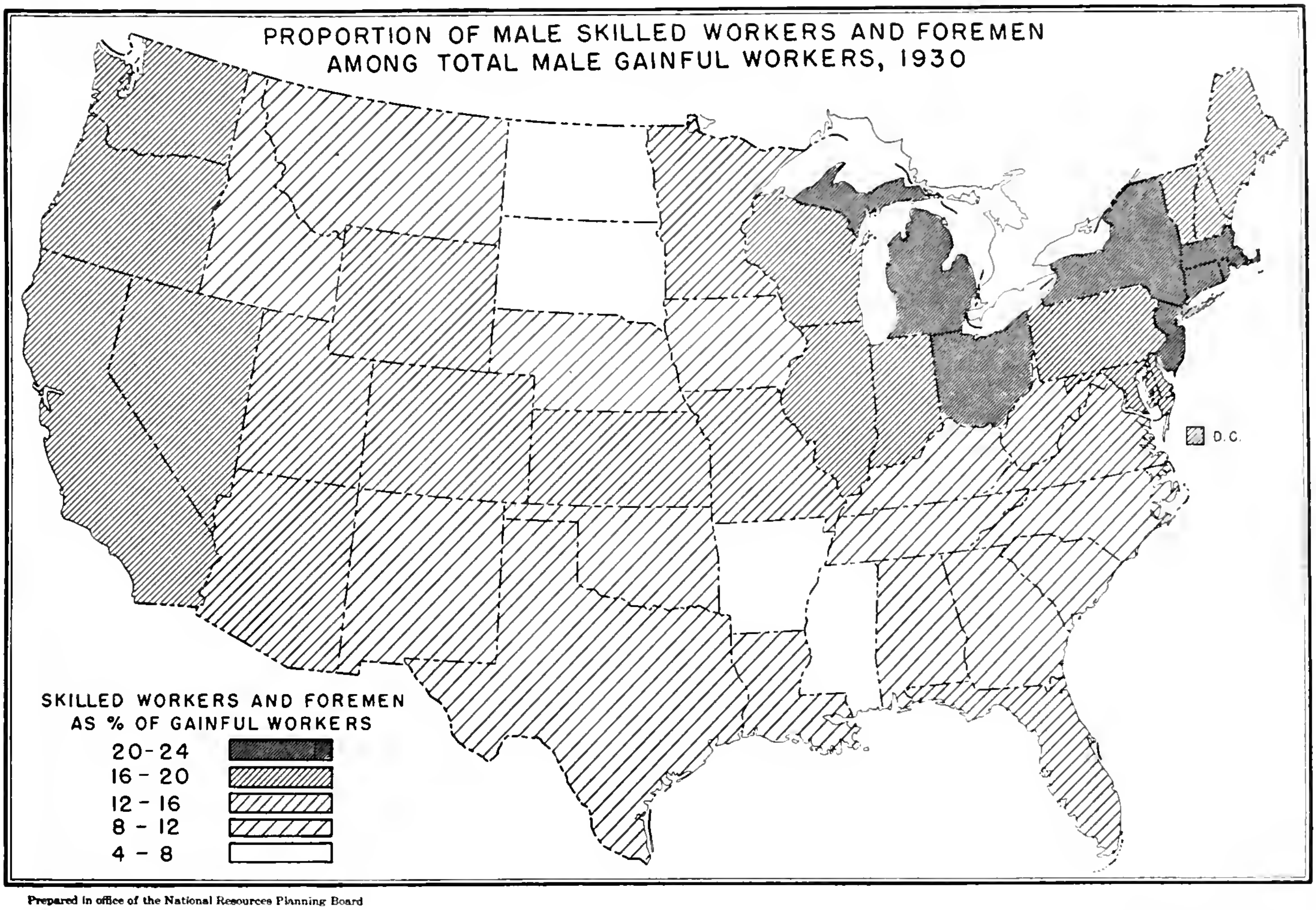
SOURCE: *Census of Manufactures*, 1939.

Influence of Specialized Skills on Location

Even though geographic differences in labor costs may be great and labor costs important to an industry, if specialized types of labor skill are demanded in substantial numbers, then the physical difficulties in getting quickly a sufficient supply of these workers in new areas may restrict the industry to developed areas in which supplies of skilled workers have grown up about the established plants.

A study of the relative proportions of different levels of skill in the gainful worker force in various industries in 1930, made by the Bureau of the Census,[5]

[5] Alba M. Edwards, *A Social-Economic Grouping of the Gainful Workers of the United States, 1930*, U. S. Department of Commerce, Bureau of the Census, 1938.



SOURCE: See footnote 5.

FIGURE 88

reveals a wide variation in the relative importance of the skilled worker and foreman grade of labor in various manufacturing industries. A frequency distribution of the ratios of the number of skilled workers and foremen to total gainful workers for 75 manufacturing industries is given in table 4.

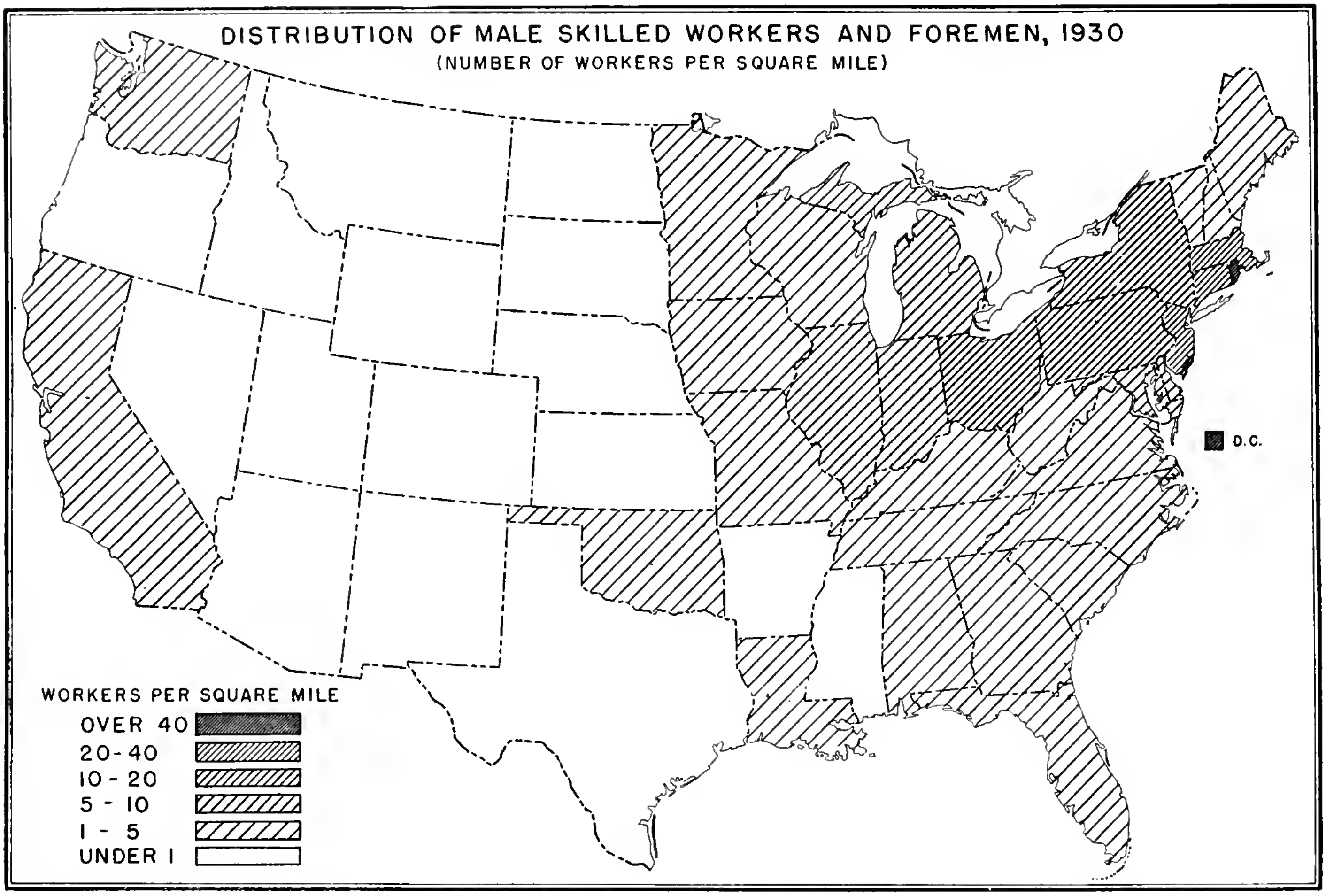
TABLE 4.—*Distribution of 75 manufacturing industries by ratio of skilled workers and foremen to total gainful workers, 1930*

Ratio of skilled workers and foremen to total workers (percent)	*Number of industries*
50 to 60	1
40 to 50	3
30 to 40	8
20 to 30	9
10 to 20	17
0 to 10	37
	75

SOURCE: See footnote 5.

The industry with the highest value for this measure of the importance of skilled labor was the suit, coat, and overall industry. The next three, in order of size of this ratio, were marble and stone yards; printing, publishing, and engraving; and ship and boat building. These industries which stand highest in skilled labor requirements would find it difficult to shift in location as general labor cost differentials develop, for the skilled labor would have to be moved to the new areas at least in part, and the wages necessary to induce immediate movement might well offset the savings on the cheaper semiskilled and unskilled labor available in the new location.

The next group of industries with ratios between 30 and 40 included such industries as furniture, automobiles, agricultural implements, and flour and grain mill products industries. Important industries in the next group with ratios between 20 and 30 were blast furnaces and steel mills, electrical machinery and supplies, petroleum repneries, and other woodworking factories.



Prepared in office of the National Resources Planning Board

Source: See footnote 5.

Figure 89

The majority of these industries which have medium to high proportions of skilled workers in their labor forces are oriented in their regional location to raw materials, and the requirement of relatively large amounts of skilled labor has been met, when labor near the location was insufficient in skill or in quantity, by labor training and migration.

In the lower range of values of this ratio are such industries as saw and planing mills, rayon, rubber, slaughtering and meat packing, cotton mills, woolen and worsted mills, silk mills, knitting mills, cigar and tobacco, shoes, and bakeries. These industries are less tied to developed locations, for they use relatively few skilled workers, but some are tied to raw materials and some to markets and hence do not respond markedly to differences in labor costs between areas.

The textile industries, however, are not so restricted by natural resource or market considerations, and they also have relatively high labor cost to total cost ratios. With differences in regional labor costs in these industries, locational shifts have taken place which tend to confirm the importance of low-cost labor in their location.

The census study of the occupation of gainful workers in 1930 also gives by States the number and proportion of the male gainful workers in the skilled worker and foreman class. Figure 88 shows this proportion of skilled workers for each State. It reveals a concentration of these workers in the group of States extending eastward from Wisconsin and Illinois to the east coast, with a secondary concentration on the Pacific coast.

Figure 89 shows the geographic concentration of these male skilled workers in terms of the number per square mile in each State. It is notable that both these measures of the concentration of male skilled workers indicate a locational pattern which corresponds closely to the concentration of all manufacturing industry in 1929. These data imply that the geographic concentration of skilled labor may act as a brake on the movement of industry into other areas, particularly the movement

or relocation of those industries which need a high proportion or large numbers of highly skilled workers. Even industries without such needs for skilled workers, however, may be restrained from developing in outside areas because of strong linkage to industries which are tied to areas of skilled labor supply.

Much of the locational effect of sources of specialized skilled labor is covered up by the fact that the original location and growth of an industry based on the earlier raw material, labor, and market conditions has determined the location of the later skilled labor supplies. To some extent, therefore, labor serves as an anchoring factor for industries needing a supply of high skills, when perhaps changes in the other conditions would indicate a shift.

The locational pulls of natural resources and markets are strong compared to the pull of specialized labor resources for the bulk of manufacturing industry, however, and the cases of a clear orientation on labor supplies from this cause do not bulk large in the general picture of location.

Technological Changes in Labor Force

One aspect of industrial operations which tends further to reduce the locational pull of highly skilled workers in the rapid technological changes that have taken place in recent years. These technological changes have passed relatively unnoticed but recent studies have shown that there has been a substantial decrease in the proportion of industrial operations that require the all-round skilled worker.

Table 5 shows the effect of such changes on the length of the training period required for workers in certain Minnesota industries. These changes have probably continued in these industries since the close of the period.

TABLE 5.—*Length of training period required, 1931 and 1936*

[Percentage of production workers]

	Less than ½ month		½ to 2 months		3 to 9 months		10 months to 2 years		2 years to 4 years		Over 4 years	
	1931	1936	1931	1936	1931	1936	1931	1936	1931	1936	1931	1936
Baking, hand operated	8	45	15	27	15	16	30	7	32	5	0	0
Baking, mechanized	53	38	27	36	6	15	14	10	0	1	0	0
Candy	(1)	32	(1)	22	(1)	12	(1)	18	(1)	15	(1)	1
Creamery	44	43	13	19	0	20	37	12	4	0	2	6
Furniture	(1)	41	(1)	32	(1)	12	(1)	9	(1)	5	(1)	1
Laundry	20	39	38	43	32	9	9	9	1	0	0	0
Metalworking	4	20	22	30	11	16	20	23	42	7	1	4
Packing	45	35	37	47	15	11	2	4	1	3	0	0
Printing, engraving	6	14	2	11	6	6	9	6	32	28	45	35
Printing, simple	0	8	48	14	20	10	8	24	20	18	4	26
Woodworking	(1)	24	(1)	21	(1)	9	(1)	37	(1)	9	(1)	0

SOURCE: Charles A. Koepke and S. Theodore Woal, *Changes in Machinery and Job Requirements in Minnesota Manufacturing, 1931–1936*, Work Projects Administration, National Research Project, and Employment Stabilization Research Institute, University of Minnesota, Report No. L–6, Philadelphia, 1939, p. 38.

[1] No comparable data.

This increase in the proportion of workers who need but a short training period might imply a general reduction in the proportion of skilled workers. However Table 6 indicates a slight increase in the proportion of the highly skilled worker, substantial increases in the lower grades of both skilled and semiskilled workers (grades B and D) and a great reduction in the proportion of unskilled workers.

TABLE 6.—*Skill of workers, 1931 and 1936*

[Percentage of production workers]

	Skilled				Semiskilled				Unskilled	
	A		B		C		D		E	
	1931	1936	1931	1936	1931	1936	1931	1936	1931	1936
Baking, hand-operated	0	0	32	6	40	22	26	68	2	4
Baking, mechanized	0	0	2	19	20	13	63	63	15	5
Candy	0	0	17	11	24	26	52	46	7	17
Cigar	(1)	0	(1)	21	(1)	20	(1)	53	(1)	6
Creamery	1	1	3	16	25	25	40	47	31	11
Dry cleaning	(2)	1	(2)	5	(2)	49	(2)	42	(2)	3
Food	0	2	3	6	23	29	45	61	29	2
Furniture	(2)	3	(2)	14	(2)	23	(2)	48	(2)	1
Laundry	0	0	2	6	30	40	58	50	10	4
Metalworking	2	7	20	23	39	36	27	28	12	6
Packing	(2)	1	(2)	5	(2)	28	(2)	61	(2)	5
Printing, engraving	26	14	29	44	19	10	22	32	10	0
Printing, simple	0	12	19	38	55	20	26	27	0	3
Shoe	0	0	1	1	80	68	17	31	2	0
Woodworking	0	1	5	20	46	29	47	38	2	12
Woolens	0	0	15	9	37	35	33	50	15	6

SOURCE: Koepke and Woal, *op. cit.*, p. 44.

NOTE:—Workers are classified as follows: A, skilled mechanics, grade I; B, skilled mechanics, grade II; C, semiskilled operators, grade I; D, semiskilled operators, grade II; E, unskilled workers. For discussion of this classification, see *ibid.*, pp. 58–62.

[1] Less than 40 workers surveyed.

[2] Comparable data not available.

It is evident, therefore, that the major change has been a mechanization of industry which has greatly reduced the proportion of the craftsman and replaced them with skilled and semiskilled machine workers, who, while they may acquire a high degree of skill on some operations or groups of related operations, are not the all-round skilled craftsmen of the less mechanized era. This mechanization has also transferred a good share of the former unskilled manual laborers to semiskilled machine-tending operations.

Testimony and exhibits submitted to the Temporary National Economic Committee in April 1940 by industrialists and labor leaders indicated that such changes are taking place on a national scale at a fairly rapid rate in many of the mechanized mass-production industries.[6] The process has two aspects that reduce the skill requirements. In the first place the development of specialized and automatic machines has reduced the skill requirements on many production jobs to the semiskilled machine-operator level from the former requirements of a

[6] See the testimony in vol. 30 of the Hearings, of Edsel Ford (p. 16343), James B. Carey (p. 16738–9, 17415), Emil Rieve (p. 16851), and Corrington Gill (p. 17232) on these points.

high level of all-round skill. Secondly, the growing emphasis on time and motion study and the breaking-down of skilled operations into simpler components which can then be apportioned to separate semiskilled operatives have further reduced the demand for general skills. Such developments have undoubtedly reduced the locational pulls toward areas in which large groups of highly skilled workers have been concentrated.

Some industrial managers and training experts have expressed the opinion that many of the young persons growing up with our modern machines such as automobiles and farm equipment have acquired a certain familiarity with machines that makes them highly adaptable to semiskilled machine operations, and that after a short training period many of these inexperienced workers can match the productivity of skilled workmen in these operations. The rapid development of conveyor systems and mechanical handling of materials has also made it possible to use a much larger proportion of female workers, although the oversupply of male workers until recently has restricted the actual use of female workers to a proportion far below that physically possible.

Conclusion

Thus, the evidence available indicates that except for a small proportion of industries in which managerial, supervisory, and craftsmen skills still bulk large, the locational hold of areas with supplies of specialized and superskilled workers has declined appreciably in recent years. The pull of sources of general labor supplies may still be strong in many industries, but the fact that the general labor force is distributed in rough proportion to the population means that many industries could probably be located more evenly with respect to population than they are now, as far as the effect of the location of the labor resources is concerned.

This development of industrial methods which minimizes the need for a large group of workers with all-round skills has increased the range of choice open to industrial managers in deciding on the proportion of labor to capital to be used in producing their goods. If the alternative methods do not differ greatly with respect to the resulting unit costs of production, areas lacking the supplies of the highly skilled workers needed for one method of production may be able to build up the necessary specialized capital equipment to make use of the available less skilled labor, and compete on a satisfactory basis with the older areas where the high skills tend to be concentrated. In some cases, indeed, the development of straight-line production methods which break the tasks up into elementary units that can be handled by unskilled or quickly trained workers has given a competitive advantage to newer industrial areas where large supplies of these workers are available at lower wages than are the rule in developed industrial areas. These lower wages may be due to such things as lower living costs and to the lack of high earning alternative occupations, this last being particularly important in rural areas where agricultural earnings are low and the population has high rates of natural increase.

The proportion of our labor force utilized efficiently differs widely between various areas, particularly since there is a large unutilized or underutilized labor supply in rural areas and small towns throughout the agricultural areas. A "ruralization" of industry has been advocated by many writers for some time, but so far major difficulties remain. While many of these difficulties are aspects of the supply and utilization of other productive resources and some are aspects of the relation of orientation to the market, some difficulties arise with respect to the labor force.

In the first place a good deal of the rural labor force is needed part of the year on the farm, and year-round operation of industrial plants drawing on this labor source might be difficult. In the second place, the industrial plant to be able to compete with plants in other locations must be of at least a certain minimum size. In cases where this minimum sized plant is relatively large, the establishment of a plant using a large number of workers in a rural area means that many of the workers must either commute long distances or move their homes close to the plant. With the widespread ownership of automobiles some commuting is possible, but the time and expense involved are likely to be a real burden to the workers, and the lack of housing near the plant and the cost of building are likely to make a shift of residence difficult. The workers may also find it difficult to keep efficient in two such unrelated occupations, if part-time industrial employment is combined with farming operations.

Many industries are to a degree integrated with other industries, and unless a general movement of the related industries takes place (which may aggravate the housing problem in rural areas), the establishment of an isolated plant close to such labor resources may be uneconomical.

On the whole, the present location of the labor force seems to be relatively unimportant as an independent factor in determining the location of most manufacturing industries over broad geographic areas. As a part of the general population, however, the labor force is concentrated in areas in which other necessary resources and services are located and in which also the markets

are concentrated. The disadvantages of locating an industrial plant away from these sources of labor are so intermingled with perhaps even stronger disadvantages with respect to the other locational forces, that no accurate estimate can be made of the independent effect of labor on location.

The present location of the general labor force or of the various special types of skill and ability within the general labor force, should not be taken as fixed data in considering location. The general westward expansion of our population in the last century and the large rural-city migrations in this century are illustrations of the high degree of mobility of the American worker.[7] The Committee on Interstate Migration reported[8] that a conservative estimate of city to city migration that led urban workers to cross state lines in 1937 totaled four million persons and that the migration of agricultural workers and their families added another million migrants to this figure. This migration seems to have been generated mainly by the push of bad employment conditions in the origin areas rather than the pull of better conditions in the terminal areas. During the periods of general economic expansion it is likely that the pull toward the areas of greatest opportunity would become a dominant factor, while the improvement in conditions in depressed areas (if the expansion was quite general) might eliminate some of the aimless and uneconomic migration of the depression period.

The large-scale migration of workers involves heavy costs to the workers and their families and to society collectively, because of the resulting maldistribution of social capital such as schools, etc., with respect to the needs of the changed population distribution. In addition, overmigration (that is, migration of more than the number of workers needed in expanding areas or the migration of the wrong types of workers) is a pure waste of human resources and may leave the migrants stranded in even worse conditions than they left.

Because of these social costs there is much to be said for the encouragement of new industrial opportunities for workers in those areas in which the push behind migration develops. A rather careful balancing of the relative efficiency of moving plants to the workers instead of workers to the plants, and a full consideration of the social costs to be saved by eliminating overmigration, might indicate many situations in which educational and advisory action by government agencies would lead to a more economic utilization of our labor resources.

[7] See Carter Goodrich, and others, *Migration and Economic Opportunity*, University of Pennsylvania Press, 1936, and the Select Committee to Investigate the Interstate Migration of Destitute Citizens, House of Representatives, 77th Cong., 1st sess., *Report*, House Report No. 369, 1941.

[8] *Ibid.*, p. 465.

CHAPTER 12. CAPITAL

By Charles P. Wood*

The capital required to finance an industrial project consists of the investment in the site, buildings, and equipment, and the money needed for organization and operation. This capital may sometimes be supplied by an individual owner or partnership, without any corporate structure, but is usually raised from investors through the sale of bonds, preferred stock, or common stock,[1] any one of these three classes of securities being employed by itself or in conjunction with either or both of the others. The funds secured by such means may be supplemented by bank loans, but these can be obtained, as a rule, only for short terms to provide for needs or contingencies arising out of current operations.

The amount of capital represented by the sale of first mortgage bonds[2] should be no more than the forced-sale value of the tangible assets. The comparative safety of this investment is reflected in low interest rates. It is obvious that buildings and equipment which are substantially constructed, comparatively standardized, or readily adaptable for other operations have a higher mortgage rating than they would if they were more specialized or subject to unduly high rates of depreciation or obsolescence. The location of the site and the adaptability of the land and improvements for other purposes, in case of emergency, affect the amount that can be included in the first mortgage risk.

The success of an enterprise, and therefore the safety of the investment, may depend in large measure upon the proper choice of a location. Moreover, in case of liquidation or forced sale, the residual value of the property may be higher at some locations, for example, those at which operations can probably be resumed, than at others.

Conversion and Mobility of Capital

There is a wide variation in the proportion of capital required for land, buildings, and permanent fixtures in different industries. This is one reason why the choice of plant location is so much more important in some industries than it is in others. Some operations, requiring light equipment, easily movable and adaptable to rented or comparatively inexpensive buildings, can be transferred from place to place without serious loss, while others would involve the loss of a large part of the original investment if required to move. A garment factory, for instance, housed in standardized loft buildings and using light sewing, cutting and pressing machines, can change location and follow the market or favorable operating conditions with very little risk or expense as compared with a steel mill or a Portland cement plant.

Before expenditures for the site or construction are authorized, every care and precaution should be taken to ensure that the location chosen is likely to prove the most suitable one. After construction or occupancy, a large amount of the company's resources is frozen at the location selected, and any change of location may involve an expense too heavy for the average manufacturing concern to bear.

The Ford Motor Company moved its chief operations from Highland Park to River Rouge because technological advances and commercial expansion had rendered the old plant obsolete and too small. Prospects and earnings were ample to justify the investment in the new plant. An earlier example is the development of new facilities by the United States Steel Corporation at Gary, Ind., to replace older plants in the Pittsburgh district and to install improved equipment at the most economical concentration point for ore and fuel. In this case, as with the location of the Bethlehem Steel plant at Sparrows Point, Md., the saving due to the transportation of ore by water was a major factor. Besides these cases, where very large expenditures were involved, there are many other less conspicuous examples in which old plants were deliberately abandoned in order to avoid replacement of obsolete or worn-out equipment at places where operating conditions were no longer favorable. The important thing to be determined in all cases, large and small, is whether operations at the new locations will increase profits sufficiently to pay a good return on the required extra investment.

While a large investment in buildings and machinery tends to tie an industrial concern to its original location, such an investment may enable the location to be selected with less regard to other production factors, especially prevailing wage rates and the market. If the labor cost per dollar of output is decreased by resort to more efficient machinery, management may

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[1] Needless to say, these securities, in the order named, entitle their holders to priority of claim, both for dividends and in liquidation.

[2] There are various subclasses of bonds, such as first mortgage, second mortgage and debenture bonds, which rank in descending order although they all take precedence over preferred stock.

view with more equanimity a location in an area of higher-priced labor, with perhaps attendant advantages of being nearer to market. While the newer machines may make the company purchasing them dependent upon more specialized employee skills, the tendency is to develop processes which are more automatic, so that the requisite labor can be obtained in a wider choice of regions or districts.

Capital in large amounts is particularly necessary to mass or quantity production, which in certain industries, notably iron and steel, automobiles, and meat packing, is the key to important economies. Use of larger-scale methods forces a greater concentration of production at certain points within favored areas. Corporations of sufficient size to build and operate such huge plants would be virtually nonexistent without the means of mobilizing capital on a grand scale.

Plants may have to be located at one place rather than another in order to be near a supply of materials, labor, or power, to enjoy transportation facilities, or to be within easy reach of markets. More rarely does the question of accessibility to capital enter as a separate locational consideration. For capital is extremely mobile and tends to flow freely, not only within a country, but from country to country, to wherever it can find profitable employment. Its movements are not restricted to areas of comparative safety, for it can be attracted into more hazardous fields by the lure of a prospective return commensurate with the risk involved.

The development of the corporate form of organization, the adoption of the limited liability principle, and the growth of stock exchanges, together with the evolution of rapid means of communication and transportation have, during the past century, vastly increased the mobility of capital. Previously, when capital was much less fluid, the existence of a local supply of capital often acted as a magnet to draw industry. The early history of American manufactures affords many illustrations of the clustering of industrial establishments about particular centers partly because capital was available there and would be ventured only in enterprises of a familiar kind located nearby, where their progress could be directed or watched. The expansion of the cotton industry in and around Providence, R. I., for example, may be partially explained in this way.

It must be noted, however, that in earlier times it was perhaps more common than it is today for a concern which had got well started to finance its further growth by plowing back earnings, thereby freeing itself from the influence of outside capital when new sites for expansion were to be chosen.

To the extent that the mobility of capital is still imperfect, its readier availability in some places than in others may remain a locational force, and it is to a consideration of the circumstances that tend to make capital mobility imperfect and their bearing on problems of location that the rest of this chapter is chiefly devoted.

Limitations of Personal Experience

The selection of a location for an industrial plant is sometimes influenced by the affiliated influences and personal preferences of those who own or control the necessary capital. This is one of the reasons why plant locations do not always comply with technical requirements.

The limited number of places with which individuals, including bankers and financiers, are familiar accounts for much of the narrow point of view about the location of plants. It may be difficult to demonstrate the advantages of a remote or unknown place to individuals, however good their intentions, who know another place so much better and who are more skeptical about some place they cannot visualize so well. There is, of course, a distinction between capital in the abstract and the personal preferences of the individual capitalist, also between the large investor and the small investor and between all of these and speculators. The banker or professional financier may be comparatively impersonal about investments but is inclined, nevertheless, to give more consideration to the location of a plant at a place with which he is familiar or where he has influence than he would to a strange place. The small investor may be even more apt to favor the place he knows or in which he already has a stake, because his investment represents a relatively larger part of his personal savings, and he is accordingly more cautious about venturing far afield. Ease of supervision may also be a factor favoring location near the investor.

"Venture" Capital

The most potent financial element affecting location is the capital needed to launch an undertaking, commonly known as "venture" capital. It is used to perfect a process, to secure a patent, to start an organization, to purchase a site, or, in general, to cover the preliminary requirements of the project, with provision for initial operations.

The only security offered in the beginning may be an idea and the development of this idea may be a patent, a process or an enterprise which will justify additional investments. On the other hand, the project may fail.

The capital which assumes the initial risk, therefore, may be available only on comparatively exacting terms, some of which may control the location of the manufacturing plant.

Influence of Financing Methods on Location

A major limitation on the mobility of capital is the fact that few enterprises can satisfy the requirements for listing on an important stock exchange. Without a listing, a concern may have to look for capital to a very limited group of investors, perhaps mainly or entirely to investors who can be interested only by the proposed location of the concern in their own neighborhood. Localities likely to constitute suitable locations for an industry may compete with one another for its acquisition by offering, through chambers of commerce or other organizations, to guarantee the provision of local capital on favorable terms.

Business conditions at the time when money is needed for a new enterprise affect the methods of raising capital and these methods may determine the extent to which capital will influence the location of the plant.

Financial weakness or the lack of elements attractive to the investment market may make an industry susceptible to contingent offers of financial assistance. Control of the plant location may be one of these contingencies. When an offer to buy a stock issue is made conditional on the location of the plant at some particular place, then, of course, the location may be influenced by capital. If it proves that this influence has been exerted in the interest of a place which combines as many major advantages as could be found at another place, it may still be argued that another location just as good might have been chosen except for the influence of capital, but no fault can be found with the actual choice. The distinction between what may be claimed as advantages may be too narrow to make it possible to state authoritatively which of several places is definitely the best location; so there may be latitude for preference and local influence to modify the decision without prejudice to the success of the resultant operation.

Questions of financing and location require decisions before manufacturing plants can be erected. Therefore, these two factors will come up for discussion at the same time, independently of how they may be related otherwise. The more they are discussed concurrently, the more likely they are to become interrelated in more ways than might have seemed possible beforehand. The influence of capital on location is greater for this reason than it might be if location were one of the later items in the organization schedule. The choice of location is one of the early major decisions during the formative period of an enterprise, while capital and management are getting acquainted, and capital may be expected to exercise its prerogatives more fully at this time than after management has assumed its full responsibility. Hence capital exerts a stronger influence in a new organization than in the expansion of a successful enterprise.

Methods of financing differ with conditions in the localities where money is to be raised and these conditions vary from time to time. When business is good and average earnings are high, there is a good market for industrial securities; so the sales can be distributed among a large number of individuals and the control retained by a comparatively small block of stock. At another time or place, only larger investors may be interested and they will want to have a voice in control through one or more directors if not actually through agreement with a majority of the stock owners.

The concentration of a majority ownership of stock or bonds in one community carries with it sufficient influence to cause the plant to be located at that place, at least as long as it affords advantages reasonably comparable with those offered by possible alternative locations. The fact that so many industries can consider a choice of location and so many places offer equivalent advantages confirms the opinion that control of capital can be an important factor in location.

The simplest operation (in theory) is for the promoters of a project to sell enough common stock to raise all the money needed, then for the stockholders to elect directors to represent them and determine the policy of the company. The location of the plant involves questions of policy often enough to assume that the directors will take an active interest in it and express preferences based on personal experience or knowledge bearing on the relative advantages offered by certain places. A majority of directors, representing financial control, can always override the management. Where this majority is primarily interested in the same place the preference is assured for that place unless it can be shown clearly to be inferior to another place as a location for the plant.

Influence of Branch Plants

The financial strength or commercial importance of a concern may be greater, relatively, than the size of the plant would indicate. This may be due to a common ownership with other properties or to collateral interests. The effect is to make the plant in itself more important locally than the same plant would be if operated by a weaker or less influential concern. This is logical because the larger concern should have

broader experience and greater means for developing improved methods and for carrying out plant expansions.

It seems that financial strength and commercial importance should tend to make a concern independent of any single plant location, because such a concern would have means for building and operating other plants or for changing the location of a plant. Actually, financial interests generally act as a centralizing influence and the plant which is at the same place as the headquarters of the company is important out of proportion to its size. The seat of financial control is the probable location of executive headquarters.

When the largest of several plants is also the headquarters of or in the same place with the executive offices of the company, its relative importance is obvious. There are many cases, on the contrary, where the industry has grown away from its original location and where a branch has become the principal producing unit. The reasons accounting for the growth of the branch plant may not apply to the headquarters of the company, although these reasons do sometimes govern the location of the main office as well as the plant.

The present Aluminum Company of America was organized in Pittsburgh in 1888 as the Pittsburgh Reduction Company. Its financial headquarters and executive offices have always been in Pittsburgh but its most important manufacturing units, whose location is due to large supplies of cheap hydroelectric power, are at Niagara Falls and Massena, N. Y., Alcoa, Tenn., and Badin, N. C. This is a conspicuous example in which a centralized financial and executive office has maintained its location away from manufacturing operations. It is cited to show that the influence of a number of branch plants may be to prevent selecting any one of them as executive headquarters, especially where none of the plant locations coincides with a financial center.

Effect of Investing Local Capital

Local capital, intelligently invested, promotes diversification and serves to encourage the new industries which are needed to supplement existing local industries and thus to protect local investments and improve the local economy. The incentive affects local investors as well as outsiders already interested in the local industries. Such investments are helpful especially to small industries which have not attained sufficient importance to attract professional investors or to have their securities listed on the exchanges.

Local banking accommodations are important as an inducement for the location of industry, because such accommodations reduce the amount of working capital which has to be provided in advance from other sources. The influence of the bank extends beyond the immediate vicinity of the city, over an area which may include other cities in cases of banks which have large resources and specialized knowledge of industrial requirements. Local banking accommodations, for such purposes as residential building and the expansion of retail business, contribute indirectly to the inducements for industrial development.

The availability of local capital for developing industrial enterprises is a strong influence on the location of industries. As between two places with equal natural advantages, the one with capital to invest has the greater influence on location. This influence may be direct in cases of new industries seeking additional capital or indirect where the new industry needs no financial assistance. The investment of local capital in related projects or local services, which contribute to convenient operation of a plant or good living conditions for employees, is an example of indirect influence which could not be exerted by a community without capital.

Within any given area where conditions are favorable for the development of an industry, the exact location of a plant may be determined less by the technical advantages of any one place than by the residence of some individual who controls capital. Familiar examples of how the location of industries has been affected by local residents with capital to invest, or with the ability to obtain capital, may be called to mind by the association of the following names with important industrial activities in the vicinity of their respective homes: Ford, Dodge, Durant, Dow, and Packard in Michigan; Willys in Toledo; Armour, Swift, and Pullman in Chicago; Eastman in Rochester; Carnegie, Frick, and Mellon in Pittsburgh; du Pont in Wilmington; Libbey in Toledo; Studebaker in South Bend; Skinner in Holyoke; Hanes and Reynolds in Winston-Salem; Duke in Durham; Rockefeller in Cleveland; Watson and Johnson in Binghamton; Paterson in Dayton; Verity in Middletown; Weir in Wheeling; Schwab in Bethlehem; Pope, Colt, and Underwood in Hartford; Kaiser in Los Angeles; Spreckles and Crocker in San Francisco; Candler in Atlanta; Busch in St. Louis. The comparatively new southern cotton mill industry is built around the names of individuals whose control of capital enabled them to establish mills at or near their homes. These names include, among others, Cannon, Irwin, and Cone in North Carolina; Schoolfield in Virginia; Montgomery, Smythe, and Springs in South Carolina; Anderson, Bradley, Callaway, and Lanier in Georgia; Comer in Alabama.

Domination by Capital

The question naturally arises as to why the owners of a company, interested primarily in a return on invested capital, should ever favor any but the best location for a plant, when a mistake might jeopardize their investment. The answer is that there are comparatively few such extreme cases of vital advantages and disadvantages and that the location factor can be relegated to a subordinate position by insistence that sound financial policy demands that the center of operations be kept within easy observation of the owners. There are cases where this policy is amply justified, depending somewhat upon the comparative abilities of the financial executive, representing ownership or financial control, and the operating executive. When properly balanced, these abilities function towards the best economic solution but it must be admitted that financial control generally takes advantage of its dominant position in any difference of opinion with the technical or operating divisions of an organization. The choice of location for a plant is one of the subjects which offers a field for honest differences of opinion based on different assumptions and different points of view.

One advantage of the financial position in the case of a controversy about plant location, or any other question at issue with the operating department of a business, is that the owners may be able and willing to pay for their own mistakes, whereas the operators must show a profit or admit failure.

The exceptional cases, where financial policy is colored by manipulative influence, have to be included in a realistic discussion. A new plant location may be used as a pretext, in the absence of some better reason, for issuing more stock, merging with another company, or for some other speculative financial scheme. Local interests may encourage unsound financial ventures in their enthusiasm to promote a new enterprise for a community and so become the innocent means of diverting productive capital to nonproductive channels. The manipulation of industrial management by financial control for purely speculative purposes has many other phases, which are beyond the scope of this chapter, and plant location is by no means the best example that could be mentioned in this connection.

A practical illustration of how financial control can maintain an arbitrary position in plant location, is an actual consolidation of two chemical companies by professional financiers, long enough ago for conclusions to be drawn from operating records. Company A was the smaller and less important of the two companies, located in the same city with a strong investment banking house. Company B, in another city, was larger, older and more important. It was owned locally and was so identified with the city that the stockholders never gave a thought to its moving away. Years of success had developed a complacent attitude in the management, more in keeping with a public institution than a competitive manufacturing business. The management of company A, on the contrary, was unusually alert and on the lookout for a chance to improve its position.

Companies A and B attracted the attention of local bankers, who saw the opportunity to combine the two companies by what would be a profitable financial operation for the bankers and what would seem to help both companies by providing better management and more working capital and eliminating duplicate facilities. During a period of active underwriting, aided, possibly, by the liquidation of some estates, the bankers acquired voting control of the common stock interest in both companies. The owners of company B considered themselves fortunate in having become associated with such a strong financial organization, which would be able to provide improved facilities and protection for the investment. The bankers, on the other hand, were primarily interested, as financiers, in building up the value of company A by consolidation with company B. Company A was in the same city with the bankers and its success was largely dependent upon the consolidation. Its management was the more aggressive of the two and more amenable to control by financiers than was the management of company B, which felt secure in its record of success and in its partial ownership of the business.

Vacant space in a building owned by company A was given as the reason for moving manufacturing departments from the B company plant. The B company buildings were older and in some need of replacement and repair, but production costs were lower at the B company plant and the B company employees had most of the specialized knowledge of manufacturing needed in the business. The cost of moving could have been applied to improvements which would have made B company buildings good enough for all practical purposes. There was no valid operating argument for moving the larger manufacturing plant to a city where operating costs were known to be higher, but the policy of the new financial control was to make company A the principal operating unit and to replace company B management with management from company A headquarters. Stockholders of company B objected when they found that their city was losing an industry, but they were outvoted, and their protests were in vain. This merger went the way of many other mergers, which were overfinanced and managed more to make an immediate profit on financing than to in-

sure a future profit on operations. The record shows a net loss to company B stockholders. The case is mentioned to show that the usual plant location advantages or disadvantages are not taken at face value when they conflict with a policy advocated by the financial interests which control a majority of the stock. These interests may have commercial influence strong enough to compensate for operating disadvantages. On the other hand, they may use the company only as a medium for a profit on financing, after which the stockholders are left to repent at leisure.

General Considerations

Freedom to take advantage of the best location and to provide the best equipment involves ample capital. Conditions which restrict the amount of capital also limit opportunities to select the best location. Recourse to loans, in the form of preferred stock or bonds, to raise capital may be accounted for in at least two ways. Credit resources may be sufficient to take advantage of low interest rates so that control which rests in the common-stock issue need not be disturbed by the need for capital. Such conditions leave the management at least as free to operate as if there were a larger amount of common stock and no funded debt. The influence on location would be little different, because the securities would be readily marketable in more than one locality.

On the other hand, when the reason for raising money by the sale of preferred stock or bond issues is that the common stock does not offer sufficient security to attract buyers, emphasis will be on the assets behind the preferred stock or bonds, and the owners of these senior securities probably will insist on being actively represented on the board of directors. The intrinsic value of the plant might be higher at one place than at another, while its value based on earnings might be the same or lower. Owners of bonds would be influenced by the former, because they would have a prior claim in case of liquidation, in which case the higher residual value would insure a better return.

Reference to financing by the sale of common stock has assumed that management of the property rests with those owning or controlling a majority of the original issue. This control might shift before the location was chosen. The controlling block might be acquired by new interests during the organization period, or it might become necessary to sell more stock than originally intended, so that what was expected to be 51 percent and control might become a minority interest in a larger issue. These changes of stock ownership might easily lead to changes in management policy and preferences for location.

Capital may be needed when there is no market for common stock, and after the plant has been built. The value of the plant, as security for an issue of preferred stock or bonds, may be affected by the location. It would be easier to justify a loan where the liquidation value of fixed assets would be assured than where there would appear to be no demand for the plant and equipment in case of failure. This consideration would account for the preference given to locations where industry is diversified, where transportation facilities are ample, and where conditions justify the conversion of the plant to more profitable use in case the original venture fails. Reorganization under these circumstances requires that the common stock surrender claim to assets needed as security for a loan and that dividends be deferred until after service charges on the loan have been paid. It is conceivable that the bondholders might move the plant to a better location. This would be more practicable with conventional buildings and light equipment than with specialized buildings and heavy or built-in equipment. Prospects at the new location would have to be sufficiently hopeful to assure the payment of moving expenses out of increased profits.

The bondholders, in the majority of cases where they assume control to avert failures, may be expected to insist on curtailment rather than to favor such major expenditures as would be required by a change in location. The consolidation of branches into centralized plants is probable in cases where reduced earnings have made it necessary to borrow money. This corresponds with consolidations of departments in a single plant, except that the latter does not involve change of location.

There is an important distinction between the capital borrowed at a low rate of interest, when credit is good, and the capital borrowed when the need for money is so pressing that the resources are pledged as security in a final effort to provide funds which may keep the company going until its financial condition can be improved by better business. In the first place, the management and the financial control remain undisturbed, so long as there is evidence of resources to pay service charges on the loan and to accumulate a reserve for its retirement. The location of the plant, under these conditions, would appear to be of little concern to the creditors. In the latter case, however, the security offered by the fixed assets might have a higher liquidating value in one location than in another, and so the location might be a factor in the ability to borrow money as well as in the amount that would be loaned.

It might be argued that liquidation is out of the question when prospects are good enough to attract

investors to a new enterprise. Such an optimistic outlook would fail to take into account important precautions in the selection of a location and the influence of capital in such cases would tend to be more conservative than the influence of management. The extremity to be borne in mind is that the bondholders may have to take over the plant and decide whether to operate it or to liquidate it. The location might influence this decision as to operation or liquidation more than it would affect the amount realized by liquidation. A good location might offer inducements for the bondholders or creditors to attempt to recover more from operating profits than would be possible by sale of the property. One advantage of operation by the creditors is that fixed charges are reduced to the bare essentials of the bonded debt, thereby reducing operating costs. Another advantage is that the bondholders have authority to release incompetent management and to insist on rigid economy to a greater extent than other owners could have done. Where too much stock was sold and the proceeds were dissipated in nonproductive expenditures, such as excessive salaries and bonuses or speculation, the reorganization by the creditors may offer the only solution for continued operation. Many failures have been converted into successful enterprises in this way. The original investment in common stock, in such cases, is generally a total loss but something has been gained for the community if the plant has been kept running and employment provided for residents. Capital may be expected to avoid taking chances and to subordinate minority interests before assuming any obligation to operate a plant which has failed. The influence of capital on location then becomes a question of whether the industry will go out of existence or continue at the place where it started. Looking ahead to the worst that might happen, then, there is a reason to give up minor advantages of location in favor of the place where financial interests might prefer to assume responsibility for operating an industry.

Some of the conditions under which new ownership might transplant an existing industry have been mentioned to show that the influence of capital on plant location may extend beyond the time when the original location is selected. It may become desirable, from a financial point of view, to combine the plant with one or more other units, to move it to another place where the ownership has other interests which would be affected favorably thereby, or to close the plant as a matter of policy or to prevent losses. The deliberate purchase of a plant for the purpose of eliminating competition or controlling production raises the question of monopolistic influence, which is discussed in chapter 16.

The question of location should be reconsidered when major expenditures are required to replace old or obsolete buildings or equipment or to rebuild after fire or other accidental damage to the property. New capital needed to rehabilitate the plant may take over control from the original owners; so a new policy as to location may be initiated by the new owners. Even if there were no changes of policy or control, the management might take advantage of the opportunity to move to a better location before adding to the investment in the old plant.

CHAPTER 13. MANAGEMENT

By Glenn E. McLaughlin*

The requirement for management as a factor in determining plant location decisions has increased materially in recent decades with the increase in the size of manufacturing units in several industries and with the development of large industrial concerns operating several plants. To the extent that a locality or a region possesses management ability of a distinctive type or quality, the locality or region is in a stronger position to attract those industries or types of concerns requiring that ability. On the other hand, it should be noted that the development of large corporations has increased the remuneration which can be paid to unusually capable business leaders and thus probably has made management ability more mobile.

Importance of Management

The importance of management as a location factor depends on the type of executive and technical personnel required. In some industries general business ability is sufficient. Moreover, there is probably little difficulty in most sections of the country in finding managers for the small business units engaged in many consumers' goods and service industries. On the other hand, a large concern or plant, especially in certain industries with complicated processes, may require highly trained management ability at the top and in addition a whole series of junior technicians and executive personnel to direct and integrate various functions which are not so clearly differentiated in a small concern. Production control absorbs a larger part of the internal efforts of such a concern or plant. In certain industries, relatively large technical and administrative staffs are needed, either because the industry is growing rapidly or because frequent changes in production techniques and industrial organization are being made. In addition, some industries are more highly specialized in their processes than others. A chemical plant is likely to require a more technically trained executive and supervisory force than one devoted primarily to assembly or packaging.

One indication of the importance of management and technical personnel in particular industries can be obtained by comparing the size of this group with that of all employees. Naturally, in some branches of nonmanufacturing activity with typically small units, the proportion of proprietors and professional personnel is large; for example, in professional services, agriculture, and trade. The distribution of these pursuits is clearly not determined mainly by regional differences in the required types of business and professional personnel, although the availability of certain professional capabilities may be influenced by the location of facilities for education and training. Among manufacturing industries, the relative importance of the management group is high in liquors and beverages, sails and similar canvas products, butter and cheese, paints and varnishes, and miscellaneous food products. These industries are widely scattered and include a host of small plants. Professional personnel appear to be relatively the most important in chemicals, metallurgical, and electrical equipment industries.

Regional Differences in Management

Variations in local leadership may contribute to the choice of plant locations and thus help account for regional differences in the growth of industry. Local leadership in innovations, promotional activity, and management may stimulate the industrial life of an area. It is, however, clearly impossible to determine the extent to which expansion in local industry is the result of unusually capable leadership or, for that matter, even to measure effectively the existence of regional differences in industrial leadership. Perhaps regional differences in management skill are not so much differences in quality as in type of ability. They appear to stem from local dissimilarities in racial background, natural resources, and industrial experience. New England, for example, probably has been the most clearly differentiated industrial section of the country because of the ingenuity and practical skill of her manufacturers and the acute commercial sense of her business men. These qualities have their origins in a long-continued economic struggle in an area with a paucity of resources. For another example, the thoroughness, thrift, and technical skill of the Pennsylvania Dutch may explain some of the industrial characteristics of Pennsylvania.

There are obviously other influences operating in such instances. In older parts of the country, for example, the thrift and skill of the population may be modified by the continued emphasis in the community on the operations of a single industry. In this way the industrial age of an area may further affect the type of man-

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agement required by local industries. Also, where few changes in local industrial organization are occurring, the management staff is likely to consist primarily of men skilled in management of routine affairs rather than in the development of new procedures and new processes.

If management ability is plentiful there is a greater chance of industrial activity being scattered. Under such circumstances trained men are more willing to move to other areas and are more willing to work for newer, less well-established concerns outside of leading production centers. But if men capable of managing certain types of concerns are found only in certain cities because they are trained in local educational institutions, research institutes, or industrial concerns, new firms may be more likely to locate in such restricted zones. One reason given for the concentration of steel plants in the Pittsburgh area, for example, is the ease with which experienced personnel can be recruited in that area. It is easier to attract men away from other producers if they can continue to reside in the same district.

Professional men as well as business managers may not be eager to move to nonindustrialized parts of the country or from large to small cities. Their unwillingness to enter a community where their scientific or trade relationships are likely to be restricted may act as a bar to the decentralization of industry. Doubtless the incentive can be made great enough to cause a sufficient staff of such men to move to a new plant site. In some instances of plant shifts, concerns have found it advisable to pay the costs of moving families and of advancing junior personnel to more responsible positions. If enough key men can be transferred it may be possible to train some supervisors and foremen at the new location.

In a rapidly growing area the variety of opportunity and the possibility of increasing profits will attract men of greater initiative and men with a greater willingness to experiment with industrial methods. Thus the kind of local business leadership is in part determined by the stage of development of the individual concern as well as that of the local area.

Effect on Location of Availability of Management

In an expansion of production capacity, the requirements for a supervisory and technical staff may be such as to influence the location of the expansion. Naturally, the locational significance of management depends in part on whether the type of technical and executive personnel required is scarce or plentiful, and on the speed with which the expansion has to be undertaken. If a plant is being established during a period of depression, it is possible that the obtaining of an adequate staff presents no difficulty, whereas during a period of prosperity, the difficulty of obtaining technical and administrative staff may influence the place chosen for expansion. In the latter case, concerns may be more likely to expand existing plant units rather than to establish branch plants in separate areas. Thus, if additional management is difficult to secure, it is likely that industrial expansion will be localized, and the average size of the firm increased.

Furthermore, whenever additional capacity is urgently needed, there is a tendency to locate new units in existing production centers. Under the current war production program, for example, large concerns have regularly favored the extension of operations in and around existing plants to the establishment of new units in newer and, often in many ways, more favorably situated localities. Scarcity of additional management and the ability of present administrative staffs to supervise expanded operations have been the major considerations leading producers to favor the further concentration of operations. Only half the attention of a busy trained staff was better than an untrained staff. Even some outside firms entering the business for the first time preferred to locate at an existing concentration point of the industry, partly because it would be less difficult to recruit a staff of trained technicians and supervisors. Thus a premium on speed in constructing a plant and getting it into operation tends to lead to further localization of an industry. Eventually, however, external diseconomies may become great enough to overshadow the dangers of thinning out administrative personnel. Moreover, there is a limit to the size of operations which an executive staff can direct, and in the short run a limit to the amount of industrial activity which one community can absorb. During the current war effort to expand industrial facilities, many industries have had to move into new production centers.

In a period of business recovery, a similar scarcity of management may develop, and lead to a further local concentration of production. At such times, speed of getting into operation may also be a consideration. If, as often is the case, the desired increase represents a fraction of existing operations, the concern may decide to enlarge an existing plant partly in order to avoid dividing up its staff. Such considerations apply to a multiplant concern as well as to an independent establishment. Often the immediately desired expansion is not large enough to require the services of a separate management group.

Moreover, even when the projected expansion represents the capacity of an efficient unit, the existing productive organizations may object to dividing the operations among new regions because it would require a separation of the executive force. Some producers in fact prefer to have all of their operations under their direct supervision either because of their unwillingness to divide responsibility or because they do not voluntarily choose the inconvenience of overseeing the operations of scattered plant units. In addition, plant managers are likely to look on proposals to shift part of existing operations to new centers as a threat to their prestige. Probably because of this factor there are many instances where plant managers have persuaded boards of directors to expand existing plants rather than establish new branch plants, even when the business of the concern was growing rapidly.

Summary

Although the effect of management on location is difficult to measure, the availability of management appears to have varied regionally enough to account for some of the differences in regional rates of growth. The scarcity of management and sometimes its unwillingness to divide operations among several plants appear to have been forces working toward localization.

Resistance to movement on the part of executive and technical personnel appears to be related to unwillingness to break established professional, personal, and business associations. Although management ability is now somewhat more widely distributed than before the war, it is still concentrated mainly in a few large industrial areas. This concentration acts as a retarding influence on the spread of industry, particularly during the period of rapid expansion in industrial capacities. At such a time, executive personnel is not generally available and the resistance to movement to other areas can be a powerful force toward a further concentration of an industry in existing production centers. During the current emergency the demand for some products increased so rapidly that there was no time to train new management staffs. Under such circumstances the unwillingness to break up a management force militated in favor of expansion at existing plant locations.

CHAPTER 14. SIZE OF PLANT, CONCERN, AND PRODUCTION CENTER

By Edgar M. Hoover, Jr.*

Scale of Production [1]

For different scales of plant output, the relative production requirements and the unit costs generally vary. The basic reason for this is the imperfect divisibility of units of equipment or of labor. It is a familiar fact that a machine, for instance, can be designed to perform a given operation at a certain rate of output while at the same time it is impossible to design a machine to perform the same operation at a lesser rate without a substantial increase in the cost per piece. Another way of stating the same thing is to say that there is a minimum efficient capacity for any kind of productive apparatus.

In the case of labor the point is more obvious. Ten men may be hired for an operation, or two, or one. But part-time use of a man results in loss of efficiency, especially if the remainder of his time is spent on work not utilizing fully his training or ability.

These ultimate lower limits to the divisibility of the human and mechanical units employed in production are the main basis of the economies of large-scale production organization. It is evident that the larger the scale of output, the more nearly will it be possible to approach the condition of having each operation performed by a fully utilized and efficient-sized unit adapted to that operation alone, and unencumbered by the necessity of shifting from one operation to another. The "principle of multiples" is that maximum efficiency in the use of each unit would require a total plant capacity equal to a common multiple of the capacities of the individual units; and that the smallest fully efficient size would be the least common multiple.

The advantages of detailed specialization in production organization, then, tend to make larger-scale forms of organization in a particular industry more efficient than smaller-scale, provided that the relative prices of materials and services are no greater and that the larger product can be disposed of just as readily.

A further basis for economies in larger-sized units is the principle of "massing of reserves." Some reserves of materials, supplies, and equipment must normally be held in any plant, to provide for accidents, maintenance interruptions, and sudden variations in demand. The size of this necessary margin is not proportional, however, to the size of the operating unit; it is much less than proportional. A larger unit can safely get along with less of its resources so tied up, since to a considerable extent the fluctuations of requirements in different parts of the organization will cancel out. Essentially the same actuarial principle applies here as in any form of insurance.

A still further incentive to large-scale production is reduction in the unit price of materials, supplies, and services purchased from other enterprises. Gas, electricity, and water, for instance, are sold to industrial consumers at rates roughly reflecting the economies of large-scale supply of these essentials. Transportation rates on both materials and products are scaled down when larger (e. g., carload or trainload) shipments can be made at one time; and scheduling and other transportation services are more likely to be adapted to the interests of large shippers and receivers.

The greater bargaining power of the large enterprise, and its ability to provide its own transport facilities, work in the same direction. The complexities of administering the antidiscriminatory provisions of the antitrust laws attest to the difficulties of separating the "genuine" economies of bulk transactions from the further concessions obtainable on the basis of bargaining power.[2]

Limitations Upon the Economies of Large-Scale Production

The existence of all these advantages in the operation of larger plants does not mean, however, that efficiency increases indefinitely with added size. In many industries, all of the important economies depending on size can be fully realized in a moderate-size plant, and a still larger one would, from the standpoint of production cost, have little further to recommend it.

A fairly clear statement as to the "minimum size" for a fully equipped modern oil refinery is given in

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[1] This section owes much to P. Sargant Florence, *The Logic of Industrial Organization*, London, 1933.

[2] Certain other economies may likewise be available to large firms as such: for example, the desire of customers to be on the "preferred" list may give such a firm a more stable clientele, and size itself has some advertising value. It should be noted, however, that a firm can be large without having large plants, simply by having several branches; so these economies of large-scale firms are much less directly relevant to location than are the considerations determining minimum scale of the unit of operation.

the Temporary National Economic Committee's hearings on the petroleum industry.[3] It is here inserted to illustrate, among other things, the nature of the qualifications involved in the statement of the "minimum size" for a plant. Dr. Robert E. Wilson, President, Pan American Petroleum and Transport Company, New York City, testified:

* * * So what I have done is to take a single type of crude in refineries of three different sizes and tried to analyze the factors that go into the cost of refining a barrel of crude, and to make it simple I have assumed that this refinery made just four products, the four principal products of the industry—gasoline, kerosene, light fuel, and heavy fuel, and I have assumed they made it in about the proportion of the ordinary market demand, and I have figured what you could do with a modern refinery * * *

The size of the refineries I have assumed have been 5,000 barrels, 15,000, and 60,000, one *about as small as you could have a complete combination skimming and cracking unit of efficient design*, and one that would give room for two good-sized units of that type.

The estimated capital investment (for the 5,000 barrel refinery) is about $2,000,000, not for the unit alone, but for the complete refinery, including the necessary storage and so forth that went in * * *

The direct refinery operating expense, not including fuel, I estimate to be 16 cents, 11 cents, and 8 cents for the three plants respectively. That is almost entirely the effect of size and efficiency of these different plants. You can see that even a 5,000 barrel modern plant has a distinct penalty.

On the other hand, that penalty of 8 cents a barrel plus a few other items is not nearly as large as the penalty against a small skimming plant which starts out with a penalty of 20 or 25 cents a barrel on the value of its products and then has in addition the higher operating costs of a small plant.

The CHAIRMAN (referring to the 60,000-barrel refinery): Could the operating cost be reduced again by an even larger refinery?

Dr. WILSON. Not appreciably, by what we know now. I think that is about the ultimate from what we now know. A year from now we will know how to build still larger units, I still believe.

The development of specialized mechanization beyond a certain point is often of doubtful advantage because it involves a corresponding loss of adaptability to changing conditions. For this reason, the very large plant may actually produce (as in the refinery case just cited) at about the same level of mechanization as the moderate-sized plant, and thus lack any purely technical advantage over the latter. Equipment, procedures and personnel which are specialized in detail for a particular rate and type of production may be impossible to use efficiently at times when production falls off seasonally, cyclically, or for any other reason, or when the character of the product has to be changed to keep abreast of competition. Every new annual model of automobiles means extensive plant retooling, and a really radical change like that made by Ford in 1927 calls for a virtual rebuilding of the plant. If specifications were changed more frequently, some of the highly specialized machinery which is now set up for a year's run in an automobile factory would undoubtedly be replaced by more versatile equipment, higher in cost on any one job, but easier to adapt from one job to another.

The mass demands of the present war production program, and the shortage of skilled operators, might be expected to give rise to a demand for still more highly specialized and more automatic machinery. This has been the case to some extent; but since the paramount necessity is speed, stress has been laid upon the use of standard rather than specially built equipment.

The machine-tool industry is thus faced with a vastly increased but qualitatively simplified demand. Plants have been expanded, manyfold in some instances,[4] and the reorganization of production in this connection is of especial interest.

A recent issue of the machine-tool builders' trade journal notes that:

Quantities of from 6 to 12 (machine tools) were average lot sizes a few years ago, with a great many parts going through the shop one at a time. Today lots of 50 to 100 are common. This transition has enabled machine tool manufacturers to swing from a job-shop basis to quantity production.[5]

The same source names eight prominent machine-tool firms which have increased the use of conveyor assembly techniques, which are of course applicable only to the lighter and more standardized products or subassemblies. A general increase in degree of specialization of individual workmen is noted. For instance,

Lodge & Shipley assembles standard machines in groups, lining them up on the erecting floor. Assemblers work in gangs, with each man trained to perform certain, specific operations. As each man finishes his work on a machine, he moves along to the next in line.[6]

To attain the maximum output under present conditions of urgency many concerns in the machine-tool industry as in others have segregated their custom-built specialty lines or discontinued them altogether.

* * * The Michigan Tool Co. has adopted a policy of building only standard machines, taking care of customers' special requirements by supplying fixtures to suit the work. Assembly is expedited by this policy, since most of the men on the erecting floor now are continuously engaged in the assembly of a given type of machine.[7]

[3] Part 15, pp. 8351–8352. [Italics supplied.]

[4] *American Machinist*, vol. 85, No. 24, November 26, 1941, pp. 1185 ff.

[5] *Ibid.*, p. 1190.

[6] *Ibid.*, p. 1198.

[7] *Ibid.*, p. 1201.

* * * The George Gorton Machine Co. discontinued approximately half of its various models in order to concentrate on the fewer kinds required for defense uses.[8]

* * * The Avey Drilling Machine Co., for instance, has found it necessary to do considerable engineering work in order to show customers how standard drilling machines can be used, instead of the special equipment requested. This company, like most others in the same field, is making few machines with special tooling.[9]

Finally, the mass building of machine tools makes it desirable to set up various operations in special separate departments. For example, in various plants departments have been recently set up for: saddle-type turret lathes, ram-type lathes, universal joints, tool grinding, jigs and fixtures, electrical assembly, and machine repair. Under predefense production schedules these departments could not have operated on a sufficient scale to justify segregation.

Positive limitations upon size of plant, in the form of increased costs which may impose a fairly definite upper limit on size, occur eventually in all industries. They are especially likely to occur at a relatively small plant size in those industries in which (a) demand is subject to considerable seasonal, cyclical or irregular fluctuations, or (b) the rate of obsolescence of product or equipment is high, owing to frequent style changes or to rapid technical progress.

In these cases the increased complexity of the task of coordination in a larger enterprise may more than offset any economies of additional specialization. The effective size of the managing unit, or firm, then restricts the size of the producing unit.

It is hardly possible to draw a definite line, of course, between management and labor requirements. In times of rapid forced expansion, not only the top managers but the technical staffs can be used more fully in a larger plant, and the same applies to skilled operatives when a policy of "dilution" or of more minute specialization of jobs by degree of skill is undertaken. One old hand may be able to look after several newcomers, whether they are being trained to do the same job as he does or merely the less exacting stages. Often the quickest and easiest way to expand physical capacity is by enlargement of existing plants, even in cases where with a slower rate of growth a smaller scale of plant organization would be preferable. However, when it is a question of making fullest use of existing physical capacity in the industry, to take care of an abrupt rise in demand, an increased reliance on small "marginal" plants for specialized operations may be feasible in some industries. The current subcontracting activities in connection with defense production bring this out, as does the following statement on the silk industry:[10]

An important factor in the rapid rise in the number of small establishments from 1914 to 1921 was the increase in commission weavers operating small establishments with comparatively few looms (usually second-hand) and the increase in many "family shops" with only four or five workers. The growth of this type of business was particularly marked immediately following the war when *the heavy demand for silk products induced concerns unable to fill their orders to contract work to small operators.* [Italics supplied.]

Some indication of the normal relationship between the size of the firm and the size of the plant can be gleaned from data presented in a recent Temporary National Economic Committee monograph.[11] In table 1 below are listed those industries in which fewer than 10 percent of the wage earners were controlled by "central office" firms; that is, at least 90 percent were in single independent establishments.[12] In 15 of these industries, with a total of 14,090 wage earners, no central-office firms whatever were reported.

In the main, the industries in table 1 are relatively small and small-scale ones, producing highly differentiated products for unstable markets. Individual exclusive features, reputation, and annual or seasonal styles are important factors in determining the market for any one firm's output. Variety of products, irregularity of demand, and low capital requirements facilitate the entry of new competitors into many of these fields. It is safe to say in most of these cases that the limit upon concentration of production in single plants is set primarily by the fact that the character of the product and its markets put a premium on originality and flexibility, thus limiting the size of plants indirectly by limiting the size of firms.

Table 2 lists individually some of the industries at the opposite end of the scale from table 1—that is, those in which more than 80 percent of the wage earners were in establishments controlled by central offices. In these cases, it is evidently feasible for one firm to manage a larger volume of business than it pays to concentrate in a single plant. The limitation upon plant size here, then, must arise from some factor other than management.

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[8] *Ibid.*, p. 1197.

[9] *Ibid.*

[10] Willard L. Thorp and others, *The Structure of Industry*, Temporary National Economic Committee, Monograph No. 27, 1941, p. 45.

[11] Cf. *Census of Manufactures, 1935*, p. 5:

"As a rule, the term 'establishment' signifies a single plant or factory. In some cases, however, it refers to two or more plants operated under a common ownership and located in the same city, or in the same county but in different municipalities or unincorporated places having fewer than 10,000 inhabitants. On the other hand, separate reports are occasionally obtained for different lines of manufacturing carried on in the same plant, in which event a single plant is counted as two or more establishments. *In every industry, however, the difference between the number of establishments and the actual number of plants or factories is negligible."* [Italics supplied.]

[12] Thorp and others, *loc. cit.*

TABLE 1.—*Industries in which the relative importance of central-office operations was especially small, 1937* [1]

Industry	Number of central offices	Establishments				Wage earners		
		Total in industry	Operated by central offices			Total in industry	In central-office establishments	
			Number	Average per central office	Percentage of total		Number	Percentage of total
All manufacturing industries	5, 625	166, 794	25, 699	4. 6	15. 4	8, 569, 231	4, 380, 123	5. 1
Shirts (excluding workshirts), collars, and nightwear (contract factories)	6	120	13	2. 2	10. 8	12, 024	1, 118	9. 3
Electroplating	8	547	15	1. 9	2. 7	8, 256	688	8. 3
Leather goods, n. e. c.	10	322	12	1. 2	3. 7	7, 103	591	8. 3
Miscellaneous articles, n. e. c.	11	595	17	1. 5	2. 9	15, 854	1, 153	7. 3
Jewelry	10	974	12	1. 2	1. 2	20, 368	1, 235	6. 1
Woolen and worsted dyeing and finishing	5	53	5	1. 0	9. 4	2, 563	120	4. 7
Coats, suits, and separate skirts, women's, misses', and juniors' (contract factories)	5	762	9	1. 8	1. 2	18, 923	627	3. 3
Millinery (regular factories)	4	723	6	1. 5	. 8	21, 321	543	2. 5
Dresses, excluding house dresses	8	1, 275	16	2. 0	1. 3	43, 874	985	2. 2
Clothing, men's, youths', and boys' n. e. c. (contract factories)	6	935	10	1. 7	1. 1	43, 953	681	1. 5
Fur goods (regular factories)	4	1, 590	7	1. 8	. 4	12, 798	115	0. 9
Billiard and pool tables, bowling alleys, and accessories	--------	23	--------	--------	--------	530	--------	--------
Blouses, women's, misses', and children's (contract factories)	--------	64	--------	--------	--------	2, 554	--------	--------
Carpets and rugs, rag	--------	35	--------	--------	--------	429	--------	--------
China firing and decorating, not done in potteries	--------	16	--------	--------	--------	306	--------	--------
Engraving (other than steel, copperplate, or wood), chasing, etching, and die sinking	--------	77	--------	--------	--------	2, 152	--------	--------
Feathers, plumes, and manufactures thereof	--------	61	--------	--------	--------	559	--------	--------
Fur goods (contract factories)	--------	52	--------	--------	--------	154	--------	--------
Furnishing goods, men's, n. e. c. (contract factories)	--------	31	--------	--------	--------	759	--------	--------
Hair goods	--------	35	--------	--------	--------	434	--------	--------
Handkerchiefs (contract factories)	--------	16	--------	--------	--------	932	--------	--------
Knitted outerwear (contract factories)	--------	164	--------	--------	--------	2, 715	--------	--------
Lapidary work	--------	51	--------	--------	--------	217	--------	--------
Millinery (contract factories)	--------	32	--------	--------	--------	239	--------	--------
Statuary and art goods (except concrete), factory production	--------	99	--------	--------	--------	858	--------	--------
Wool scouring	--------	20	--------	--------	--------	1, 252	--------	--------

SOURCE: Willard L. Thorp and others, *The Structure of Industry*, Temporary National Economic Committee, Monograph No. 27, 1941, pp. 152, 211-225, 226.

[1] The industries here shown include all those for which central-office data could be published without disclosures and which had less than 10 percent of their wage earners in central-office establishments.

TABLE 2.—*Industries in which the relative importance of central-office operations was especially great, 1937* [1]

Industry	Number of central offices	Establishments				Wage earners		
		Total in industry	Operated by central offices			Total in industry	In central-office establishments	
			Number	Average per central office	Percentage of total		Number	Percentage of total
All manufacturing industries	5, 625	166, 794	25, 699	4. 6	15. 4	8, 569, 231	4, 380, 123	51. 1
Smelting and refining, copper	7	23	20	2. 9	87. 0	14, 514	14, 238	98. 1
Blast-furnace products	31	87	80	2. 6	92. 0	23, 075	22, 264	96. 5
Oil, cake and meal, linseed	7	23	18	2. 6	78. 3	2, 628	2, 523	96. 0
Cars, electric and steam railroad	29	154	137	4. 7	89. 0	40, 466	37, 355	92. 3
Compressed and liquefied gases	22	356	321	14. 6	90. 2	4, 655	4, 289	92. 1
Explosives	10	77	53	5. 3	68. 8	5, 406	4, 958	91. 7
Coke oven products	33	94	71	2. 1	75. 5	20, 603	18, 825	91. 4
Petroleum refining	49	365	215	4. 4	58. 9	83, 182	75, 817	91. 2
Cigarettes	7	34	19	2. 7	55. 9	26, 149	23, 816	91. 1
Sugar, beet	10	87	76	7. 6	87. 4	9, 366	8, 429	90. 0
Gypsum products	13	79	53	4. 1	67. 1	5, 207	4, 668	89. 6
Wood preserving	50	197	152	3. 0	77. 2	12, 401	10, 963	88. 4
Files	5	21	7	1. 4	33. 3	3, 715	3, 274	88. 1
Asbestos products other than steam packing and pipe and boiler covering	14	73	30	2. 1	41. 1	13, 023	11, 441	87. 9
Smelting and refining, zinc	14	25	22	1. 6	88. 0	11, 265	9, 878	87. 7
Nonclay refractories	14	40	25	1. 8	62. 5	5, 641	4, 918	87. 2
Rubber tires and inner tubes	9	46	25	2. 8	54. 3	63, 290	54, 918	86. 8
Chemicals, n. e. c.	111	601	362	3. 3	60. 2	78, 951	68, 362	86. 6
Steel-works and rolling-mill products	79	410	233	3. 0	56. 8	479, 342	414, 144	86. 4
Roofing, built-up and roll; asphalt shingles; roof coatings other than paint	17	111	58	3. 4	52. 3	7, 418	6, 378	86. 0
Motor-vehicle bodies and motor-vehicle parts	62	936	161	2. 6	17. 2	284, 814	214, 985	85. 0
Tin cans and other tinware, n. e. c.	32	224	128	4. 0	57. 1	33, 145	27, 988	84. 4
Shortenings (other than lard), vegetable cooking oils, and salad oils	11	48	36	3. 3	75. 0	4, 901	4, 091	83. 5
Soap	22	232	41	1. 9	17. 7	14, 008	11, 540	82. 4
Motor vehicles, not including motorcycles	14	131	63	4. 5	48. 1	194, 527	159, 973	82. 2
Asphalted-felt-base floor covering	6	13	8	1. 3	61. 5	3, 280	2, 663	81. 2
Rayon and allied products	8	33	20	2. 5	60. 6	55, 098	44, 523	80. 8
Glue and gelatin	18	75	34	1. 9	45. 3	3, 547	2, 867	80. 8

SOURCE: Thorp and others, *op. cit.*, pp. 152, 211-225.

[1] The industries here shown include all those for which central-office data could be published without disclosures and which had 80 percent or more of their wage earners in central-office establishments.

It will be noted that the industries of table 2 are in many respects opposite in character from the "one-plant firm" industries listed in table 1. They make mainly staple products calling for a considerable degree of capital investment, with stable demand and relatively unspecialized labor. The food industries are prominent in the list, especially certain ones in which the character of the material or product compels decentralization and small-scale production.

More than a third of all central offices extend their operations into two or more industries, and over half of all central-office establishments belong to these "complex" firms.[13] Consequently the percentages in table 2 may give an exaggerated idea of the degree of concentration of production of individual products in single firms. Table 3 lists those industries in which single-industry firms operated more than 20 percent of all establishments. It will be observed that the lists are fairly dissimilar. The three industries included in both are: Railroad cars, beet sugar, and wood preserving.

TABLE 3.—*Industries with over 20 percent of establishments in single-industry central-office companies, 1937*

Industry	Establishments		
	Total number	In single-industry central-office companies	
		Number	Percent of total
All manufacturing industries	166, 794	11, 321	6. 8
Sugar, beet	87	66	75. 9
Cars, electric and steam railroad	154	66	42. 9
Cement	158	64	40. 5
Paving materials (excluding brick and stone)	148	55	37. 2
Ice, manufactured	3, 847	1, 415	36. 8
Hat bodies, carded wool-felt	14	5	35. 7
Underwear, men's (contract factories)	9	3	33. 3
Fireworks and allied products	50	16	32. 0
Wood distillation and charcoal manufacture	60	19	31. 7
Wood preserving	197	59	30. 0
Minerals and earths, ground and treated	157	47	29. 9
Canned fruits and vegetables	2, 772	822	29. 7
Gloves and mittens, cloth aud cloth and leather	107	31	29. 0
Fuel hriquettes	21	6	28. 6
Cast iron pipe and fittings	75	21	28. 0
Carpets and rugs, wool	55	15	27. 3
Silk throwing and spinning (commission)	96	23	24. 0
Drug grinding	21	5	23. 8
Sausage casings, not made in meat-packing establishments	31	7	22. 6
Bluing	14	3	21. 4
Rice cleaning and polishing	61	13	21. 3
Clay products, excluding pottery	1, 198	255	21. 3
Buttons	291	59	20. 3

SOURCE: Thorp and others, *op. cit.*, table 18, p. 156.

Economies of Local Concentration of Industry

Many items of production cost depend not so much upon the scale of organization of the plant itself as upon the magnitude and scope of the local industrial concentration. There are thus economies and diseconomies dependent upon the degree of local concentration of an industry, or related industries, and independent both of the size of the individual plant units and of the size of firms.

Many of these "external economies" are based on the availability of more and more specialized auxiliary and service enterprises with increased concentration of the main industry. Thus, the garment factories of a large garment center like New York have the advantage of a retinue of enterprises furnishing materials, supplies, equipment, storage, and various kinds of service including contract work, financing, and merchandising. Some of these perform such specialized functions that in a smaller garment center they could not exist at all on the business available, and these functions would be combined with others at some sacrifice of technical efficiency. The same is true of most other industries. The larger the volume of production in any one local area, the greater the advantage secured through specialized auxiliary industries. Thus the local concentration of an industry (including its auxiliaries) is subject to economies of size based upon specialization. These economies are available to all the plants of the industry in the area of concentration, regardless of their own individual size; in fact, the availability of service enterprises makes possible a very narrow specialization of functions in relatively small plants.

Relative Localization of Immediate vs. Ultimate Markets

For many types of manufacturing, considerations of access to market have a much more concentrative effect than would appear from the pattern of geographic distribution of the final consumers. Thus the marketing of products tends to "funnel" through a few major centers, and so far as the producing industry is concerned, the immediate markets are located at the main clusters of producers.

Some of this market funneling is present in practically all lines of consumers' goods, as a result of the advantages of large-scale selling. Its extent varies widely, however, according to the character of the commodity.

"Convenience" items can be bought through local wholesalers or (by larger retailers) direct from the manufacturers. Both wholesale and retail markets are relatively scattered, and the manufacturer need not locate near his competitors for the sake of facilitating comparison of his goods with theirs. At the other extreme, "specialty" goods are those in which the buyer knows in advance that he probably wants a specially made product or the product of a particular manufacturer. Dealings in specialty goods are consequently direct in most cases. Here again, marketing considerations impose no great pressure toward concentration of the industry.

[13] *Ibid.*, table 16, p. 152, and table 17, p. 154.

This leaves the middle category of "shopping" goods, which are selected only after comparison of different lines. It is in this field that the funneling tendency of the market system really assumes importance, and in which it becomes advantageous for the manufacturer to be near his rivals. He may, of course, merely maintain a showroom in the market center and operate his factory elsewhere; but such a separation involves expense and inconvenience which can be justified only by relatively large economies in production costs at the outside location.[14]

It is difficult to get a quantitative picture of the extent of this concentration of marketing in shopping-goods lines, owing to the variety of ways in which the goods may pass from the manufacturer to the retailer. To the extent that they are sold through wholesalers, of course, the "market" from the manufacturer's point of view is where these wholesalers are. We should expect, then, to find considerably more concentrated distribution of wholesaling in the "shopping" lines than in others.

This is borne out by the available statistics. Items such as staple groceries, drugs, hardware, lumber, farm machinery, alcoholic beverages, and tobacco products have no seasonal style changes, and show a relatively dispersed pattern of wholesaling. In each of these lines, the 4 leading States combined accounted in 1935 for less than half the national total of wholesale trade, as shown in table 4; and in full-line grocery wholesaling, even the 10 most important States barely accounted for half. Since practically half the total retail sales in the United States in 1935 were made in the 8 States of New York, Pennsylvania, California, Illinois, Ohio, Texas, New Jersey, and Michigan, the lines of wholesaling just mentioned may be regarded as regionally distributed in fairly close correspondence to the pattern of ultimate consumption.[15]

In sharp contrast are such lines as clothing, dry goods, housefurnishings, jewelry, and optical goods, in all of which the greater part of national wholesale sales is concentrated in one or two States. In each case, New York is by far the leading State; and in the clothing, dry goods, and "general merchandise" fields, New York City alone accounts for well over half the national total of net sales.[16]

In many of these lines, only a minor part of the trade goes through wholesale houses. However, in the shopping-goods lines the larger retailer who buys direct from manufacturers must still shop before he buys. Ordinarily a sizable retail store dealing in such lines will send buyers to a central market city (generally New York) several times a year, and an undetermined but very large percentage of the actual selections are made there. The smaller or remoter retailer who cannot afford such frequent trips is, to a growing extent, utilizing the services of resident buyers or buying groups in the market centers.[17]

TABLE 4.—*Major kinds of wholesale business according to degree of geographic concentration, 1935*

	Leading States
At least half of United States total sales in 1 State:	
Dry goods (specialty lines)	New York.
General merchandise	Do.
Jewelry and optical goods	Do.
Clothing and furnishings	Do.
At least half of United States total sales in 2 States:	
Amusement and sporting goods	New York, California.
Drugs and drug sundries (specialty lines).	New York, Illinois.
Furniture and house furnishings	Do.
Metals and metal work (excluding scrap).	New York, Ohio.
Chemicals and paints	New York, Illinois.
At least half of United States total sales in 3 States:	
Coal and coke	New York, Massachusetts, Illinois.
Petroleum and its products	Ohio, Massachusetts, New York.
At least half of United States total sales in 4 States:	
Dry goods (full line)	Illinois, Missouri, New York.
Electrical goods	New York, Pennsylvania, California.
Farm products (raw materials)	Texas, New York, Minnesota.
Farm products (consumer goods)	New York, Illinois, Pennsylvania.
Paper and its products	Do.
Waste materials	New York, Ohio, Pennsylvania.
At least half of United States total sales in 5 States:	
Groceries and foods (specialty lines)	New York, California, Illinois.
Machinery, equipment, and supplies	New York, California, Texas.
At least half of United States total sales in 6 States:	
Automotive	New York, California, Ohio.
Beer, wine, and liquors	New York, California, Illinois.
Tobacco and its products	New York, California, Pennsylvania.
At least half of United States total sales in 7 States:	
Farm supplies	New York, California, Missouri.
Lumber and construction materials	New York, Illinois, California.
Plumbing and heating equipment and supplies.	New York, Pennsylvania, Illinois.
At least half of United States total sales in 8 States:	
Drugs (full line)	California, New York, Illinois.
Hardware	New York, California, Missouri.
At least half of United States total sales in 10 States:	
Groceries (full line)	New York, Pennsylvania, California.

SOURCE: Census of Business, 1935. *Wholesale Distribution*, vol. IV: Kinds of Business, table 1-A, pp. 3-31.

[14] High rents, labor costs, and taxes have led some clothing manufacturers, for instance, to leave New York City; but they have in practically all instances chosen locations either just outside New York or in some other very large center.

[15] The measure of localization of wholesaling relative to retailing used here is, of course, merely a rough short-cut. For a more refined and accurate measure, Professor Florence's coefficient of localization would be preferable. (See Chapter 3 above.)

[16] In table 5 below are shown the percentage shares of New York City in national totals of sales in 16 major kinds of wholesale trade. In 1935 New York City accounted for 8.5 percent of the national total of retail sales.

[17] The growth of these buying agencies and groups, and the increasing importance of chain stores, have played a large part in cutting down the importance of the old-line wholesaler. See for example, Norris A. Brisco and John W. Wingate, *Buying for Retail Stores* Prentice-Hall, New York, 1937, ch. XI, including the following passage on pp. 270–271:

"In the New York market alone, there are over 600 market representatives in the dry-goods field, representing about 7,000 stores with a combined sales volume of about 2½ billion dollars. While much of the ordering done by stores is direct from vendors, the offices have a decided influence in the buying of the majority of the fashion merchandise and some of the staples bought by the stores concerned. Of the total number of offices about 54 percent specialize in apparel, about 24 percent in millinery, 11 percent in men's wear, 8 percent in general department store merchandise, and 3 percent in furs. (Based on an analysis of the directory: Phelon's *Resident Buyers*.)"

TABLE 5.—*Sales of full-service and limited-function wholesalers in major kinds of wholesale business, in the United States and in New York City, 1935*

[Groups in which New York City's share was less than 15 percent are excluded]

Major kind of business	United States sales (thousands of dollars)	New York City sales: Thousands of dollars	New York City sales: Percent of United States
Dry goods (full-line and specialties)	985, 400	636, 838	65
General merchandise	361, 647	216, 200	60
Clothing and furnishings	648, 881	343, 519	53
Jewelry and optical goods	180, 685	88, 797	49
Metals and metal work (excluding scrap)	281, 996	132, 850	47
Furniture and house furnishings	243, 457	105, 816	44
Chemicals and paints	275, 301	116, 753	42
Amusement and sporting goods	117, 045	39, 952	34
Paper and its products	408, 935	102, 535	25
Groceries (specialty lines)	1, 682, 961	370, 604	22
All wholesalers	17, 661, 691	3, 974, 160	22
Farm products—consumer goods	1, 941, 059	402, 372	21
Coal and coke	368, 695	62, 626	17
Farm products—raw materials	1, 562, 487	250, 645	16
Plumbing and heating	243, 173	38, 164	16
Drugs and sundries (full-line and specialties)	447, 582	66, 531	15
Machinery, equipment, and supplies	835, 647	122, 638	15

SOURCE: Census of Business, 1935, *Wholesale Distribution*, vol II, table 1, pp. XVIII–XXI, and table 1, pp. 184–186. Percentages calculated.

TABLE 6.—*Lines of full-service and limited-function wholesaling in which more than half the United States total sales were in New York City, 1935*

Line	United States total sales (thousands of dollars)	New York City sales: Thousands of dollars	New York City sales: Percent of United States
Rubber (crude)	62, 436	57, 212	92
Piece goods	593, 867	514, 941	87
Notions	96, 778	81, 737	84
Diamonds and other precious stones	27, 732	22, 986	83
Clocks and watches	29, 198	24, 153	83
Women's and children's clothing and furnishings	233, 602	158, 341	68
Millinery and millinery supplies	42, 161	27, 734	66
Oils and greases (animal and vegetable)	43, 212	28, 351	66
General merchandise	361, 647	216, 200	60
House furnishings, excluding floor covering, china, glassware and crockery	69, 327	40, 565	59
Toys, novelties and fireworks	35, 393	19, 996	57
Jewelry specialties, n. e. c.	53, 843	30, 433	57
China, glassware, and crockery	33, 497	17, 889	54
Toilet articles and preparations	40, 671	21, 661	53
Cameras and motion-picture equipment and supplies	4, 897	2, 534	52
Upholsterers' service equipment and supplies	25, 636	13, 299	52
Forest products, excluding lumber	80, 373	41, 189	51

SOURCE: Census of Business, 1935, *Wholesale Distribution*, vol. II, table 1, pp. XVIII–XXI, and table 1, pp. 184–186. Percentages calculated.

Consequently the shopping-goods manufacturer, whether he sells to wholesalers, resident buyers, or retailers, must have his plant or at least his sales office in the central metropolitan market—usually New York. The following quotation from a standard text for buyers indicates that there is no tendency for this pressure to decrease: [18]

Retail buyers have always visited the central markets, but not to the extent that they are visiting them today * * *

It was probably the rise of the department store that gave the greatest impetus to the practice of visiting merchants. Department store buyers find it necessary to go to the large markets from two to as many as twenty times a year. The style character of a large percentage of the merchandise which department stores carry makes these frequent trips necessary * * *

These information-collecting tours are becoming prevalent in nearly all fields. Many merchants who have no occasion to go away to buy, visit the principal markets in their lines to get the "feel" of things, to ascertain at first hand the drift of prices, and to find out what the big men in their particular field are thinking.

In most branches of trade New York City is by far the leading market, and that city's percentage share of the total wholesale business in a particular line is a rough index of the degree of market funneling. It is only a rough index, because the other channels of trade in a given line may be either more or less concentrated than the wholesale channel. A few lines funnel through cities other than New York—for example, nearly 62 percent of the wool and mohair wholesalers' sales in 1935 was in Boston—but those are rare exceptions. Table 6 brings together some of the extreme cases of concentration of individual commodity lines of wholesaling in New York City, covering all lines in which the city's share was more than 50 percent.

For further information, tables 7–11 are added to show the industries most definitely devoted to particular channels of distribution. Unfortunately for present

TABLE 7.—*Industries distributing primarily to industrial and other large users, 1935*

[Industries with percentages below 80 are excluded]

Industry	Sales to industrial and other large users as percentage of total net sales
All industries (reported sales)	24. 5
Woolen and worsted carpet yarn	100. 0
Wool scouring	100. 0
Smelting and refining, copper	100. 0
Tin and other foils	100. 0
Collapsible tubes	95. 7
Models and patterns	94. 0
Graphite	93. 0
Lasts	92. 5
Worsted yarn	92. 1
Malt	92. 1
Textile machinery and parts	91. 9
Woolen yarn	91. 7
Hat and cap materials, men's	91. 3
Forgings, iron and steel, made in plants not operated in connection with steel works or rolling mills	91. 2
Boxes, cigars	89. 9
Yarn, dyeing and finishing	89. 7
Drug grinding	89. 4
Smelting and refining, lead	87. 5
Haircloth	86. 4
Doors, shutters, window sash, etc.	85. 1
Signs and advertising novelties	81. 8
Wool combing and tops	81. 4
Aluminum products	81. 4
Tanning materials	80. 8
Tin cans and other tinware, n.e.c.	80. 8
Jute goods	80. 7
Refractories	80. 2

SOURCE: Census of Business, 1935, *Distribution of Manufacturers' Sales.*

[18] John A. Murphy and John Block, *Buying*, Alexander Hamilton Institute, New York, 1927, Modern Merchandising Course, vol. 5, pp. 85, 86, 93.

TABLE 8.—*Industries distributing primarily to other manufacturing plants in same organization, 1935*

[Industries with percentages below 50 are excluded]

Industry	Sales to other plants in same organization, as percentage of total net sales
All industries (reported sales)	9.9
Blast-furnace products	81.7
Pulp	64.6
Motor-vehicle bodies and parts	53.3

SOURCE: Census of Business, 1935, *Distribution of Manufacturers' Sales.*

TABLE 9.—*Industries distributing primarily to retailers, 1935*

[Industries with percentages below 70 are excluded]

Industry	Sales to retailers (including chain stores) as percentage of total net sales
All industries (reported sales)	19.2
Coats and suits, women's and children's	90.0
Children's outerwear	86.7
Dresses, women's and children's	84.3
Beverages, nonalcoholic	81.0
Men's furnishing goods	80.3
Blouses, women's	78.8
Infants' wear	77.3
Billiard and pool tables, etc	77.2
Underwear and nightwear, women's and children's	76.9
Trunks, suitcases, and bags	73.9
Curtains, draperies, bedspreads	73.6
Mirror and picture frames	72.3
Pocketbooks, purses, and card cases	71.2
Corsets and allied garments	70.2
Millinery	70.2
Mattresses and bedsprings, n. e. c.	70.1

SOURCE: Census of Business, 1935, *Distribution of Manufacturers' Sales.*

TABLE 10.—*Industries distributing primarily to wholesalers and jobbers, 1935*

[Industries with percentages below 70 are excluded]

Industry	Sales to wholesalers and jobbers, as percentage of total net sales
All industries (reported sales)	23.2
Cigarettes	96.9
Collars, men's	95.5
Chewing gum	91.2
Bluing	88.2
Tobacco, chewing, smoking, and snuff	87.3
Asphalted felt-base floor covering and linoleum	85.6
Turpentine and rosin	82.6
Rice cleaning and polishing	81.2
Vinegar and cider	78.0
Firearms	77.2
Sugar, beet	75.5
Beauty-shop equipment	70.5
Gloves and mittens, cloth	70.3
Ammunition, etc	70.0

SOURCE: Census of Business, 1935, *Distribution of Manufacturers' Sales.*

TABLE 11.—*Industries distributing primarily through manufacturers' wholesale branches, 1935*

[Industries with percentages below 50 are excluded]

Industry	Sales to manufacturers' wholesale branches as percentage of total net sales
All industries (reported sales)	17.1
Soap	75.1
Explosives	74.9
Gypsum products	60.5
Petroleum refining	56.2
Smelting and refining, zinc	53.3
Salt	50.6

SOURCE: Census of Business, 1935, *Distribution of Manufacturers' Sales.*

purposes, these statistics were gathered in connection with the Census of Manufactures, and are classified according to the categories of manufacturing industry. They can therefore not be brought into exact relationship with the data in tables 5 and 6, which use the classification of the Census of Business.

The materials presented suffice to indicate the degree of variation among different commodities in the extent to which the distributive organization favors concentration of manufacturing. The use of groupings based on the Standard Industrial Classification in the 1939 and 1940 Censuses should eventually make possible a fairly accurate geographic analysis of the distribution of individual products.

Labor Costs and Localization

Another item which depends to a great extent upon concentration of an industry or of a group of industries is labor cost. Where any considerable degree of special training is called for, there is usually some economy in being located in an established center of the industry and sharing with other plants in the industry a reserve labor supply and such advantages as special training schools. Most skilled-labor industries are relatively concentrated for this reason.

Table 12 presents some relevant material on this point. The various industry groups into which the gainfully employed population of the United States was classified by the 1930 Census are there ranked in approximate order of extent of specialized skill requirements. For the purposes of this ranking, it has been assumed that unskilled, semiskilled, and clerical labor could be put in one class and the remaining group of employees (professional persons, proprietors, managers, officials, skilled workers and foremen) in the other. Such a rough classification is, of course, quite misleading in some instances. A semiskilled man or a clerk in some kinds of plant may be quite specialized, while in others he may be quite as interchangeable and available as unskilled labor. The classification used in table 12 also seriously underrates the skill of miners.

For some purposes it is preferable to omit the proprietors, managers, and officials as well; so the last column in table 12 gives the percentage of total gainful workers accounted for by the professional, supervisory,

and skilled categories only. In certain occupations (starred) in which proprietors are important, this radically reduces the percentages.

The ideal criterion of "skill" would be the time required to bring various types of labor to the point of maximum productivity, and the scarcity of these types of labor; but unfortunately data are not yet available for a comprehensive classification of occupations or industries on this basis. The essential information needed is of four sorts: (*a*) precise definitions of jobs; (*b*) the rate at which output normally increases and workmanship improves with length of experience on a job; (*c*) the extent to which innate abilities, background, or work experience facilitate learning a job; and (*d*) the ultimate potential supply of a certain skill: i. e., the number of persons capable of being trained. Much useful material on the subject has been compiled by the Bureau of Labor Statistics and other agencies.

Much depends likewise on the sex and age characteristics of the labor required in an industry, and on the variability of demand—factors which require more

TABLE 12.—*Industry and service groups in order of percentage of skilled, supervisory, and proprietary workers to total, 1930*

[(*) Asterisks indicate industries in which the percentage is lowered more than half by omission of proprietors, as in last column.]

Industry	Percentage of total gainfully employed—	
	Proprietors, professional persons, foremen, and skilled workers	Professional persons, foremen, and skilled workers only
Automobile repair shops	81.3	74.2
Professional service, excluding recreation and amusement	80.7	80.2
Building industry	78.9	72.2
Recreation and amusement	70.8	56.9
Garages, greasing stations and auto laundries	70.6	54.1
Air transportation	69.2	63.2
Suit, coat and overall factories	60.2	55.4
*Agriculture	58.0	0.7
Marble and stone yards	55.8	48.0
Printing, publishing and engraving	53.6	45.5
Ship and boat building	48.4	46.7
Car and railroad shops	45.9	45.5
Independent hand trades	42.9	42.9
Furniture factories	41.2	37.4
Flour and grain mills	40.1	30.8
Electric light and power plants	39.4	35.7
Jewelry factories	39.1	33.1
All industry and service groups	38.7	18.9
Tinware, enamelware, etc., factories	38.5	33.2
*Grain elevators	37.5	7.0
*Banking and brokerage	36.4	0.9
Wagon and carriage factories	36.1	29.9
Agricultural implement factories	36.0	32.1
Street railroads	35.5	33.6
Automobile factories	35.4	33.5
Brass mills	35.0	31.4
Oil and gas wells	34.8	27.0
Steam railroads	33.8	27.0
Electrical machinery and supply factories	33.5	30.0
*Wholesale and retail trade (except automobile)	33.1	1.8
*Automobile agencies, stores, and filling stations	32.6	2.4
Petroleum refineries	32.1	27.6
Copper factories	30.9	29.0
Gold and silver factories	30.7	27.1
*Radio broadcasting and transmitting	30.3	10.0
Blast furnaces and steel rolling mills	28.9	27.2
Piano and organ factories	27.1	22.3
Gas works	25.0	21.0
Charcoal and coke works	24.9	22.7
Pipe lines	24.8	21.6
Sugar factories and refineries	24.6	20.9
*Liquor and beverage industries	23.8	7.3
Explosives, ammunition, and fireworks factories	23.6	20.4
Lime, cement, and artificial stone factories	23.6	17.5
*Sail, awning and tent factories	23.2	6.8
*Warehouses and cold storage plants	23.2	10.8
Lead and zinc factories	22.8	20.2
Water transportation	22.6	13.1
*Livery stables	22.1	6.2
Salt wells and works	22.1	17.8
Blank book, envelope, tag, paper bag, etc., factories	21.7	15.8
Paint and varnish factories	21.7	12.0
*Cleaning, dyeing and pressing shops	21.6	1.4
Quarries	21.5	16.9
*Advertising agencies	21.1	4.8
Saw and planing mills	20.7	16.2
Soap factories	20.5	14.5
Construction and maintenance of roads, streets, etc.	19.5	15.1
*Butter, cheese, condensed-milk factories	19.5	7.2
Paper box factories	18.7	10.2
Paper and pulp mills	18.5	15.5
Iron mines	18.3	17.5
Fruit and vegetable canning	17.3	10.3
Glass factories	17.2	14.1
Lead and zinc mines	17.1	15.4
*Hotels, restaurants, boarding houses, etc.	17.1	0.7
Clock and watch factories	16.9	14.3
Copper mines	16.8	15.8
Rayon factories	15.9	15.1
Lace and embroidery mills	15.8	8.0
Gold and silver mines	15.3	10.9
Hemp, jute, and linen mills	15.2	10.0
Rubber factories	14.8	11.7
*Broom and brush factories	14.8	5.5
Rope and cordage factories	14.5	11.0
Trunk, suitcase, and bag factories	14.3	8.4
*Postal service	14.2	1.1
Textile dyeing, finishing, and printing mills	13.7	11.6
Brick, tile, and terra-cotta factories	13.6	9.0
Leather belt, leather goods, etc. factories	13.2	6.0
Button factories	13.0	9.0
Slaughter and packing houses	12.5	8.6
Forestry	12.5	4.8
Carpet mills	12.2	10.3
Fertilizer factories	11.9	7.0
Fish curing and packing	11.7	6.8
*Laundries	11.6	3.7
Telegraph and telephone	10.7	7.4
*Candy factories	10.6	4.9
Potteries	10.5	7.2
*Bakeries	10.4	2.9
*Truck, transfer, and cab companies	10.3	1.8
Tanneries	10.3	7.4
Stockyards	10.1	7.7
Harness and saddle factories	10.1	3.4
Woolen and worsted mills	9.9	8.1
Silk mills	9.5	7.5
Cotton mills	9.3	8.4
Hat factories	9.1	4.6
Corset factories	8.6	4.6
Knitting mills	8.5	6.2
Coal mines	8.0	7.0
Straw factories	7.4	5.4
Cigars and tobacco factories	7.3	4.2
*Insurance	7.0	1.2
Express companies	6.7	4.3
Shoe factories	6.6	4.8
Glove factories	6.6	3.3
Turpentine farms and distilleries	6.5	3.3
Shirt, collar, and cuff factories	5.9	3.5
Real estate	2.5	.6
Domestic and personal service (n. e. c.)	.2	.2

SOURCE: Compiled from Alba M. Edwards, *A Social-Economic Grouping of the Gainful Workers of the United States, 1930*, Bureau of the Census, 1938, pp. 124-141. Fishing has been omitted from this table, since practically all fishermen were erroneously classified as unskilled employees. Most of the "miscellaneous," "all other," and "not elsewhere classified" categories have likewise been omitted.

attention than can be given here. In general it may be said that the more abnormal the sex and age requirements or the more pronounced the fluctuations, the more advantageous it is for an industry to be located near others with complementary labor demands—or, failing that, in a large diversified labor market. It will be observed that this factor is likely to work toward the formation of diversified clusters of industry rather than toward narrow local specialization in a particular industry. It is thus a force of urbanization or geographic concentration rather than of localization. The fact that the localization of many highly localized industries seems to be decreasing, while the urban and suburban concentration of industry shows no corresponding decrease, is an indication that the forces of diversification have become more powerful.

Limitations Upon the Economies of Industrial Concentration

The advantages of geographical concentration, like those of large-scale production, in an industry, a group of industries, or in industry in general are limited. In the first place, many of the economies can be fully realized by a moderate degree of concentration, so that they furnish no incentive to further concentration beyond this "minimum" degree. In the second place, certain very definite diseconomies of concentration may enter after a certain point.

The chief diseconomy is added transportation costs. As the concentration of an industry becomes greater than that of its market, the number of ton-miles of transportation on the product increases. Thus a further geographic concentration of soft-drink bottling could be accomplished only at the expense of longer deliveries. Similarly, as the concentration of an industry becomes greater than that of the sources of its materials, the quantity of transportation required for assembling materials increases. Thus more transportation of sugar beets to refineries is required than would be the case if refineries were smaller and more scattered.

The degree of concentration which minimizes the total costs of assembling materials and delivering products is somewhat greater than that which would minimize the total number of ton-miles of product transportation. The reason for this is the existence of certain economies of mass transportation and marketing, previously mentioned. It remains true, however, that concentration of an industry very much beyond the degree of concentration shown by its material sources or markets involves increased costs of material assembly or marketing or both. This constitutes in fact the chief barrier to the full realization of the positive economies of large-scale production and geographic concentration.

Relation of Large-Scale and Concentration Economies and Diseconomies to Location

It has been indicated in the foregoing sections that the efficiency of a plant varies according to the size of the plant, generally increasing sharply till a certain "minimum efficient scale or production" is reached, and then remaining approximately constant for a considerable range and eventually decreasing. The efficiency of supervision and control of a firm likewise tends to rise with increased size, but not indefinitely. A fairly definite maximum may exist, beyond which efficiency begins to fall. In the absence of any still more restrictive limitations on the size of a plant, this "maximum efficient size of firm" may set an upper limit to plant size as well. Finally, the efficiency of a plant depends upon the degree of localization of its own and related industries. Here again, there is an initial stage in which efficiency increases as the result of economies of specialization; but here still more definitely appears a positive check on localization due to increased transportation costs as the geographic pattern of the industry deviates more and more from the geographic pattern of its material sources and its markets.

The actual size and distribution of plants, firms, and production centers in any industry depends, of course, on the combined working of the cost variations thus outlined. Since the relative force of the different factors varies according to industry and according to location, the typical size of plants, firms, and production centers also varies among industries and among different production areas of the same industry. A complete analysis of all industries being out of the question, it must suffice here to indicate statistically the principal relationships between size and localization.

Variation of Plant Size According to Type of Location

There appears to be a considerable variation in typical scale of production according to type of location.

It will be observed in table 13 that the average size of manufacturing establishments (as measured by number of wage earners) is slightly greater in industrial areas than elsewhere, and that it is much greater in the outer parts of industrial areas than in the central cities of those areas. Outside the main industrial areas the same relationship holds: the average size of plants is smaller in important cities than it is in less congested locations. However, in the least industrialized areas (G), plants average fewer wage earners than

TABLE 13.—*Average number of wage earners per establishment by type of location, 1929 and 1937*

Symbol	Type of location	Average number of wage earners per establishment			
		Actual		Percent of United States average	
		1929	1937	1929	1937
	All types (United States total)	42	51	100	100
A	Central cities of industrial areas	37	43	90	84
B	Major satellite cities in industrial areas	52	61	124	120
C	Remainder of industrial areas	77	95	183	186
ABC	Industrial areas as a whole	45	54	107	106
D	Important cities outside industrial areas	43	48	102	94
E	Peripheries of "D" cities	75	90	179	176
F	Important counties, outside industrial areas and "DE" counties	75	91	179	178
G	Remainder of United States	31	40	74	78

SOURCE: Special tabulation from Census of Manufactures data. The area symbols were used first by Daniel B. Creamer in the Study of Population Redistribution (See Bulletin Number Three, *Is Industry Decentralizing?* Philadelphia, University of Pennsylvania Press, 1935) and more recently by Harold Kube and Ralph Danhof in *Changes in Distribution of Manufacturing Wage Earners 1899–1939*, Bureau of the Census and Bureau of Agricultural Economics, 1942.

TABLE 14.—*Average number of wage earners per establishment, by types of location, 1929 and 1937*

[In types of location shown to the left of the heavy jagged line, the average size of plants was greater than the average for the industry as a whole; in types of location shown to the right of the line, plants averaged smaller than for the industry as a whole. For key to type-of-location symbols see Table 13, above.]

Industry		Rank of types of location according to average size of plant							No plants
		1	2	3	4	5	6	7	
All manufacturing industries	1929	C	E	F	B	D	A	G	------
	1937	C	F	E	B	D	A	G	------
Rubber tires and inner tubes	1929	A	F	C	G	D	E	----	B
	1937	A	F	C	D	E[1]	G	----	B
Chemicals, n. e. c	1929	E	G	C	B	A	D	F	------
	1937	G	E	C	B	A	F	D	------
Motor vehicles	1929	D	BC[1]		A	F	E	G	------
	1937	DE[1]		C	A	F	B	G	------
Petroleum refining	1929	F	C	A	B	E	D	G	------
	1937	F	C	A	E	D	G	B	------
Agricultural implements, exclusive of tractors	1929	A	F	D	C	G	E	----	B
	1937	A	F	D	C	G	E	----	B
Tractors	1929	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
	1937	F	A	C	G	----		----	BDE
Paper	1929	F	A	G	D	C	B	E	------
	1937	A	F	G	C	D	B	E	------
Cotton goods	1929	B	F	D	E	G	A	C	------
	1937	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
Boots and shoes (excluding rubber)	1929	F	G	D	E	A	B	C	------
	1937	D	F	G	E	C	A	B	------
Pottery and china firing	1929	C	D	G	E	F	A	B	------
	1937	C	D	G	F	E	B	A	------
Glass	1929	E	G	F	BC[1]		A	D	------
	1937	BC[1]		G	E	F	D	A	------
Steel works and rolling mills	1929	B	F	C	D	E	A	G	------
	1937	B	C	F	E	A	D	G	------
Silk manufactures	1929	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
	1937	A	C	FD[1]		G	B	----	E
Rubber goods (excluding tires, tubes, boots and shoes)	1929	E	B	C	A	F	G	D	------
	1937	E	C	G	F	D	A	B	------
Aircraft and parts	1929	C	A	E	G	B	F	D	------
	1937	D	CB		EF		A	G	------
Rayon manufactures	1929	(2)	(2)	(2)	(2)	(2)	(2)	(2)	(2)
	1937	FDE[1]			G	C	A	B	------
Automobile bodies and parts	1929	C	F	A	D	E	G	B	------
	1937	C	D	F	A	E	G	B	------

SOURCE: Special tabulation from Census of Manufactures data.

[1] Two or more types of location combined by the Census, to avoid disclosure of data for individual plants. Applies to cols. 1, 2, 3.

[2] Not available.

TABLE 15.—*Number of States, counties, and establishments represented in each manufacturing industry, 1935*

[Industries ranked in order of number of counties]

Industry	Establishments	States (including District of Columbia)	Counties (including District of Columbia)
Printing and publishing, newspaper and periodical	8,879	49	2,427
Bread and other bakery products	19,068	49	2,024
Ice, manufactured	3,850	48	1,588
Lumber and timber products, n. e. c	5,982	46	1,448
Beverages, nonalcoholic	3,175	49	1,317
Butter	3,458	43	1,158
Flour and other grain-mill products	2,193	49	1,129
Ice cream	2,447	49	922
Printing and publishing, book, music, and job	10,961	49	886
Planing-mill products (including general millwork) made in planing mills not connected with sawmills	2,753	49	863
Canned and dried fruits and vegetables, canned and bottled juices, preserves, jellies, fruit butters, pickles, and sauces	2,744	46	726
Machine shops	3,026	48	699
Clay products (excluding pottery) and nonclay refractories	1,074	48	536
Foundries	1,251	48	491
Concrete products	1,224	46	476
Machinery, n. e. c	2,554	43	474
Feeds, prepared, for animals and fowls	942	47	471
Marble, granite, slate, and other stone, cut and shaped	1,404	46	450
Furniture, including store and office fixtures	3,035	44	447
Meat packing, wholesale	1,223	49	437
Gas, manufactured, illuminating and heating	521	41	431
Cheese	2,573	36	425
Poultry dressing and packing, wholesale	562	37	366
Men's cotton collars, nightwear, shirts and work clothing	1,176	41	366
Wood, turned and shaped, and other wooden goods, n. e. c	756	39	338
Fertilizers	670	37	329
Cotton manufactures	1,223	30	324
Boxes, wooden, excluding cigar boxes	661	43	309
Liquors, malt	666	38	301
Knit goods	1,852	34	301
Oil, cake, and meal, cottonseed	458	15	301
Sheet-metal work, not specifically classified	1,400	45	299
Confectionery	1,314	46	288
Condensed and evaporated milk	467	38	285
Railroad repair shops, steam	416	47	282
Food preparations, n. e. c	1,029	46	275
Drugs and medicines	1,058	42	272
Boxes, paper, n. e. c	1,214	40	270
Paper	591	36	262
Women's, misses', and children's apparel, n. e. c	8,462	41	258
Electrical machinery, apparatus, and supplies	1,393	39	245
Caskets, coffins, burial cases and other morticians' goods	548	43	244
Sausage, meat puddings, head cheese, etc., and sausage casings, not made in meat-packing establishments	808	44	244
Mattresses and bedsprings, n. e. c	824	45	242
Structural and ornamental metal work, made in plants not operated in connection with rolling mills	1,111	44	236
Cooperage	406	38	232
Motor-vehicle bodies and motor-vehicle parts	820	41	232
Boots and shoes, excluding rubber	1,024	32	221
Nonferrous-metal products, excluding aluminum, n. e. c	1,098	38	218
Fabricated textile products, excluding wearing apparel and house furnishings	788	43	210
Paints, pigments, and varnishes	1,082	41	209
Men's, youths', and boys' clothing, n. e. c	2,981	36	209
Railroad repair shops, electric	259	42	208
Signs and advertising novelties	1,075	43	208
Boiler shops	413	41	204
Chemicals, n. e. c	570	40	198
Stoves and ranges (excluding electric) and warm-air furnaces	559	34	194
Brooms	348	39	193
Petroleum refining	395	31	188
Wool and hair manufactures	699	31	188
Photoengraving, not done in printing establishments	662	45	179
Grease and tallow, excluding lubricating grease	260	34	176
Insecticides and fungicides, and industrial and household chemical compounds, n. e. c	546	40	175
Ship and boat building, steel and wooden, including repair work	556	32	172
Cigars	746	34	168
Agricultural implements, including tractors	241	31	168
Bookbinding and blank-book making	1,022	39	156
Stamped and pressed metal products; enameling, japanning and lacquering	698	30	154
Steel-works and rolling-mill products	396	31	153
Turpentine and rosin	895	8	149
Pumps (hand and power) and pumping equipment	326	31	146
Wirework, n. e. c	536	30	143
Paper goods, n. e. c	547	31	141
Hardware, n. e. c	405	27	138

TABLE 15.—*Number of States, counties, and establishments represented in each manufacturing industry, 1935*—Con.

Industry	Establishments	States (including District of Columbia)	Counties (including District of Columbia)
Baskets and rattan and willowware, excluding furniture	204	33	136
Pottery, including porcelain ware	257	35	135
Tools, excluding edge tools, machine tools, files, and saws	343	30	134
Rubber goods, excluding tires, inner tubes, and boots and shoes	412	31	131
Wood preserving	181	39	131
Dyeing and finishing cotton, rayon, and silk	523	28	128
Leather, tanned, curried, and finished	384	27	128
Silk manufactures	658	18	124
Mirrors and other glass products made of purchased glass	532	32	124
Machine-tool accessories and machinists' precision tools	731	24	124
Models and patterns, excluding paper patterns	582	29	122
Compressed and liquefied gases	330	38	121
Lime	189	36	118
Pulp (wood and other fiber)	188	24	116
Toys (excluding children's wheel goods or sleds), and playground equipment	384	31	116
Electroplating	553	32	116
Men's furnishing goods	807	33	115
Miscellaneous apparel and allied products	278	28	114
Cement	153	35	112
Refrigerators and refrigerating and ice-making apparatus	275	28	111
Saddlery, harness, and whips	157	35	111
Minerals and earths, ground or otherwise treated	161	36	111
Rayon manufactures	447	17	110
Cleaning and polishing preparations	395	35	110
Sporting and athletic goods, excluding firearms and ammunition	196	33	109
Perfumes, cosmetics, and other toilet preparations	558	33	107
Waste and related products	313	33	107
Surgical and orthopedic appliances and related products	307	34	105
Flavoring extracts, flavoring sirups and related products	407	31	105
House furnishings	773	31	104
Glass	213	22	99
Steam and hot-water heating apparatus and steam fittings	275	24	96
Macaroni, spaghetti, vermicelli, and noodles	336	28	96
Plumbers' supplies, excluding pipe and vitreous-china sanitary ware	252	26	95
Vinegar and cider	125	27	95
Tin cans and other tinware, n. e. c	204	29	95
Cordage and twine; jute goods; linen goods	148	29	95
Machine tools	259	19	94
Miscellaneous articles, n. e. c	655	29	93
Engines, turbines, water wheels, and windmills	149	21	92
Brushes, excluding rubber	250	32	89
Cutlery (excluding silver and plated cutlery) and edge tools	264	24	88
Cars, electric and steam railroad, not built in railroad repair shops	150	29	88
Engraving, steel, copperplate, and wood, and plate printing	388	35	86
Printers' machinery and equipment	238	30	85
Aluminum products	170	21	83
Window shades (textile and paper) and fixtures	319	30	83
Paving materials, blocks (excluding brick and stone) and mixtures	132	25	82
Lithographing	387	32	82
Forgings, iron and steel, made in plants not operated in connection with rolling mills	185	21	81
Hand stamps and stencils and brands	277	16	79
Belting and packing, leather	187	30	79
Screw-machine products and wood screw	302	18	78
Textile machinery and parts	349	20	78
Canned and cured fish, crabs, shrimps, oysters, and clams	274	25	78
Soap	238	28	78
Cranes and dredging, excavating, and road-building machinery	127	25	76
Cereal preparations	110	31	76
Liquors, distilled	131	18	75
Fur goods	2,438	22	75
Motor vehicles, excluding motorcycles	126	25	74
Jewelry	995	32	73
Instruments and apparatus, professional, scientific, commercial and industrial	283	24	72
Lighting equipment	500	25	72
Stereotyping and electrotyping, not done in printing establishments	206	30	72
Tobacco: chewing, smoking, and snuff	115	20	71
Wall board and plaster (excluding gypsum) building insulation and floor composition	124	24	71
Synthetic-resin, cellulose-plastic, vulcanized-fiber, and molded and pressed pulp fabricated articles, n. e. c	153	19	70
Tanning materials, natural dyestuffs, mordants, and assistants and sizes	154	21	70
Buttons	297	24	70
Liquors, vinous	315	16	69
Boot and shoe cut stock and findings	489	23	69
Lubricating greases, not made in petroleum refineries	180	26	67
Leather goods, n. e. c	101	24	65
Sugar, beet	77	16	64
Roofing, built-up and roll; asphalt shingles; roof coatings, excluding paint	108	30	63
Pocketbooks, purses, and cardcases	324	19	61
Explosives	74	24	61
Oils, n. e. c	106	25	60
Radio apparatus and phonographs	196	17	58
Embroideries, trimmings (not made in textile mills); stamped art goods	1,149	23	56
Abrasive wheels, stones, paper, and cloth and related products	96	18	55
Trunks, suitcases, and bags	307	23	55
Window and door screens and weather strip	141	23	55
Steam and other packing, pipe and boiler covering, and gaskets, n. e. c	124	20	54
Wire, drawn from purchased rods	88	17	53
Rags, paper, exclusive of those made in paper mills	107	23	53
Envelopes	166	27	53
Carpets and rugs	123	18	52
Bolts, nuts, washers, and rivets, made in plants not operated in connection with rolling mills	137	18	51
Coke-oven products	88	19	51
Blacking, stains, and dressings	167	22	50
Ink, printing	191	23	50
Liquors, rectified and blended	260	20	49
Doors, shutters, and window sash and frames, moulding and trim, metal	134	22	49
Saws	82	22	49
Gypsum products	72	26	48
Gloves and mittens, leather	224	14	47
Boxes, cigar, wooden and part wooden	72	22	47
Hats, exclusive cloth hats and millinery	302	18	46
Wood distillation and charcoal manufacture	60	18	45
Aircraft and parts	79	18	44
Smelting and refining, nonferrous metals, excluding gold, silver, and platinum, not from the ore	99	21	43
Blast-furnace products	72	15	42
Asbestos products, excluding steam packing and pipe and boiler covering	70	17	42
Fireworks and allied products	52	17	42
Steel barrels, kegs, and drums	64	20	42
Dentists' equipment and supplies	87	18	41
Cast-iron pipe and fittings	71	17	40
Photographic apparatus and materials and projection apparatus	118	18	39
Musical instruments and parts and materials, n. e. c	94	14	38
Cash registers, adding and calculating machines, and other business machines, excluding typewriters	94	18	
Galvanizing and other coating, done in plants not operated in connection with rolling mills	65	20	37
Scales and balances	56	18	36
Washing machines, wringers, driers, and ironing machines, for household use	41	11	35
Glue and gelatin	74	17	35
Excelsior	48	17	35
Mirror and picture frames	169	19	35
Wrought pipe, welded and heavy riveted, made in plants not operated in connection with rolling mills	48	12	34
Furs, dressed and dyed	167	16	34
Statuary and art goods (excluding concrete), factory production	105	21	34
Salt	48	11	33
Silverware and plated ware	139	13	33
Shortenings (excluding lard), vegetable cooking oils and salad oils	48	16	33
Mucilage, paste, and other adhesives, excluding glue and rubber cement	66	17	33
Malt	54	14	32
Rubber tires and inner tubes	42	16	32
Gold, silver, and platinum, refining and alloying	88	18	32
Needles, pins, hooks and eyes, and slide and snap fasteners	50	13	31
Carriages and sleds, children's	61	14	31
Baking powder, yeast, and other leavening compounds	46	19	31
Clocks, watches, time-recording devices, and materials and parts, excluding watchcases	76	11	30
Optical goods	100	13	30
Springs, steel, excluding wire, made in plants not operated in connection with rolling mills	49	14	30
Artificial and preserved flowers and plants	190	15	30
Card cutting and designing	76	15	28
Beauty-shop equipment, excluding furniture	82	16	28
Nails, spikes, etc., not made in wire mills or in plants operated in connection with rolling mills	43	10	27
Foundry supplies	46	14	27
Lace goods	56	8	26

TABLE 15.—*Number of States, counties, and establishments represented in each manufacturing industry, 1935*—Continued

Industry	Establishments	States (including District of Columbia)	Counties (including District of Columbia)
Engraving (other than steel, copperplate, or wood) chasing, etching, and diesinking	101	13	26
Carbon paper and inked ribbons	56	14	26
Rayon and allied products	32	16	26
Soda fountains and accessories	48	16	25
Musical instruments, pianos	36	9	24
Wallpaper	40	9	24
Smelting and refining, zinc	27	12	24
Chocolate and cocoa products, excluding confectionery	44	9	23
Theatrical scenery and stage equipment	48	13	23
Felt goods, excluding woven felt	40	12	23
Pens, fountain and stylographic: pen points, gold, steel, and brass	51	11	22
Musical instruments, organs	28	13	22
Pencils, lead (including mechanical) and crayons	47	12	22
Chewing gum	26	11	22
Lasts and related products	48	11	22
Fuel briquets	24	16	22
Artists' materials	47	9	21
Musical-instrument parts and materials, piano and organ	34	10	21
Artificial leather, oilcloth	33	10	21
Matches	24	13	20
Sand-lime brick	20	14	20
Umbrellas, parasols, and canes	83	9	20
Corn sirup, corn sugar, corn oil, and starch	36	10	20
Rice cleaning and polishing	68	5	20
Jewelry and instrument cases	72	12	20
Fire extinguishers, chemical	25	12	19
Bone black, carbon black, and lampblack	55	7	18
Cork products	34	9	18
Sugar cane, excluding products of refineries	74	2	17
Sewing macines and attachments	39	9	17
Firearms	22	9	16
Gold leaf and foil	27	9	16
Motorcycles, bicycles, and parts	23	9	16
Oil, cake and meal, linseed	25	11	16
Typewriters and parts	20	6	15
Drug grinding	21	7	15
Pipes (tobacco)	29	8	15
Smelting and refining, copper	19	11	15
Bluing	15	11	15
Locomotives (excluding electric) not made in railroad repair shops	14	8	14
Cigarettes	29	9	14
Ink, writing	20	9	14
Sugar refining, cane	18	9	14
Billiard and pool tables, bowling alleys and accessories	17	9	14
Files	22	10	14
Asphalted felt-base floor covering, linoleum	16	7	13
Collapsible tubes	16	8	13
Candles	23	8	13
Hair work	43	9	13
Smelting and refining, lead	17	11	13
Safes and vaults	14	5	12
Lapidary work	60	8	12
Ammunition and related products	13	8	12
Wool pulling	17	9	12
Oleomargarine (margarine), not made in meat-packing establishments	14	9	11
Tin and other foils, excluding gold foil	10	9	10
China firing and decorating, not done in potteries	19	7	9
Oils, essential	12	7	9
Boots and shoes, rubber	12	7	9
Graphite, ground and refined	9	6	8
Watchcases	29	7	8
Cardboard, not made in paper mills	16	8	8
Jewelers' findings and materials	73	4	6
Feathers, plumes, and manufactures thereof	73	4	5
Combs and hairpins, not made of metal or of rubber	11	5	5

SOURCE: Compiled from 1935 Census of Manufactures data in U. S. Bureau of Foreign and Domestic Commerce, *Industrial Market Data Handbook*, 1939.

anywhere else.[19] This relationship appears to have held consistently between 1929 and 1937, at least.

The great variation in size seems to arise mainly from the fact that the larger cities specialize in certain typically small-scale industries. This is more clearly indicated when individual industries are examined, as in table 14. We find there very little consistency in the relationship of size to type of location among the 17 selected industries. In four cases (tires, implements, paper, silk) the largest average size is in the central cities. On the other hand the chemicals industry shows a marked tendency toward larger plants in outlying areas (E, G, C).

Relative Cluster and Scatter of Plants in Different Industries

The different degree of clustering of plants in different industries is well shown by examining the distribution of plants by counties. In table 15 the individual industries are listed in the order of the number of counties (out of a total of 3,098) in which each was found in 1935. One industry—newspaper and periodical printing—is found in nearly 4 out of 5 of the counties in the United States, while several others appear in more than 1,000 counties each. At the other extreme, the feather and comb industries are found in only 5 counties each.

In terms of number of States, the variation runs all the way from one found in only two States to several industries found in every State including the District of Columbia.

Industries with only a few establishments are naturally likely to be found in fewer locations; so in order to make allowance for this, and get a truer measure of cluster tendency, Figure 90 has been prepared. Each industry is there plotted as a point, with its horizontal position representing the number of establishments and its vertical position the number of counties. Both scales are logarithmic. The "normal" relationship between number of establishments and number of counties is indicated by the trend line, fitted by the method of least squares. It is interesting to note that this trend has a slope of less than 45°, which means that the average number of establishments per county is generally greater in industries with large numbers of establishments.[20]

Now the extent to which an individual industry deviates from the normal trend of relationship may be regarded as a measure of its positive or negative "clus-

[19] This bears out Prof. P. Sargant Florence, who found that the average number of wage earners per manufacturing plant in 1929 was lowest in the counties with fewest manufacturing wage earners and that this average size of plant first increased and then decreased with increasing numbers of wage earners in the county. (*The Long-Range Planning of the Location of New Productive Capacity* (mimeographed). National Resources Planning Board, October, 1940, table 11, p. 11.)

[20] The equation of the fitted regression line in fig. 1 is $C=1.66\ E^{0.704}$ where C represents number of counties and E number of establishments. If the number of counties tended to be proportional to the number of establishments, the exponent in the formula would be 1. The fact that it is only 0.704 indicates a systematic tendency for the number of counties to increase less than in proportion to the number of establishments. Thus for an industry with 50 establishments, the "expected" or trend-line number of counties would be 26 (with an average of 1.9 establishments per county). For an industry with 5,000 establishments, the expected number of counties would be 660 (with an average of 7.6 establishments per county). These figures are obtained by substitution in the formula.

RELATION BETWEEN NUMBER OF ESTABLISHMENTS AND NUMBER OF COUNTIES REPRESENTED IN EACH MANUFACTURING INDUSTRY
1935

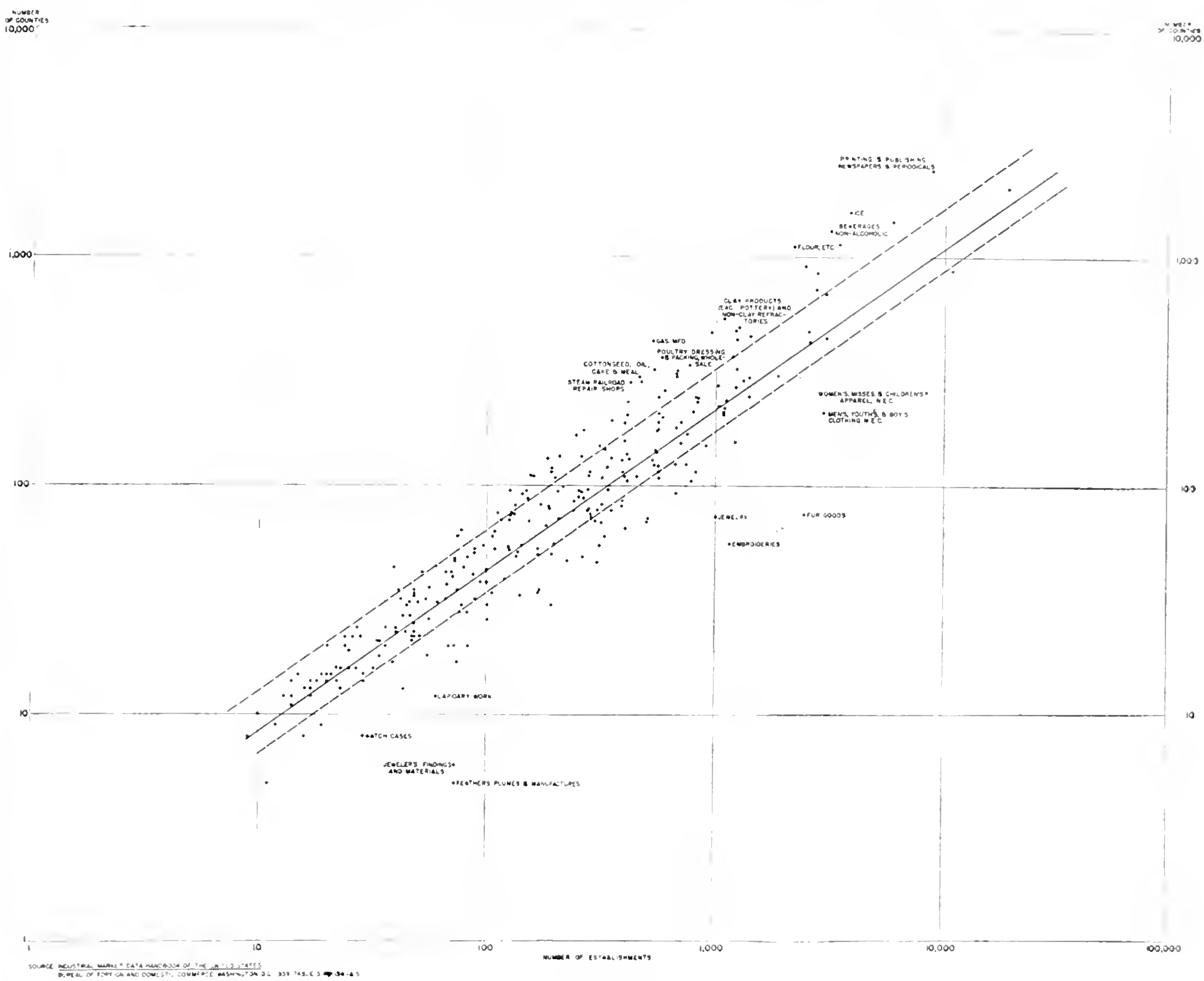

FIGURE 90

ter tendency." For instance, the two industries farthest out of line are "Feathers, plumes, and manufactures thereof" (below the line) and "manufactured gas" (above the line). The feathers industry is found in many fewer counties than would be expected on the basis of the number of its establishments—that is, it is exceptionally clustered—while the manufactured gas industry is found in many more counties than would be expected on the basis of the number of its establishments—that is, it is exceptionally scattered.

Since interest naturally attaches to the more extreme cases, several of the most clustered and the most scattered industries are individually labeled on the chart. In tables 16 and 17, the industries comprising the most clustered and the most scattered 20 percent are listed in order of their degree of departure from the usual relationship.[21]

Industries With Clustered Plants

In this type of industry the optimum size of production center is large relative to the optimum size of plant. Evidently, in such cases, the requirement of a

[21] Since the diagram is on a logarithmic or "ratio" scale, any given distance from the line always represents the same percentage deviation of the actual from the "expected" number of counties. The deviations in the 2 extreme cases are: Feathers industry, expected counties 34, actual counties 5, deficiency 86 percent; manufactured gas industry, expected counties 137, actual counties 431, excess 215 percent. No other industries are as far out of line in the respective directions as these 2.

certain minimum efficient size of plant has no effect on the location of the industry, since economies of local concentration always call for a volume of local output greater than this minimum. The geographic pattern of such industries is primarily composed of a series of clusters of plants at major distributing points, skilled-labor centers, or (rarely) raw-material collection points. Isolated individual plants are the exception.

TABLE 16.—*Fifty-six industries with greatest relative cluster (constituting bottom quintile of distribution relative to regression of number of counties on number of establishments), 1935*

[Listed in order of degree of departure from usual relationship, most unusual case first]

Rank	Industry	Average value added by manufacture per establishment	
		Thousands of dollars	Percentage of average for all industries
1	Feathers, plumes, and manufactures thereof	14	12
2	Jewelers' findings and materials	85	74
3	Fur goods	23	20
4	Embroideries, trimmings (not made in textile mills), and stamped art goods	21	18
5	Women's, misses' and children's apparel, n. e. c.	62	54
6	Jewelry	41	36
7	Lapidary work	14	12
8	Men's, youths', and boys' clothing, n. e. c.	86	75
9	Watchcases	145	126
10	Artificial and preserved flowers and plants	30	26
11	Hats, excluding cloth hats and millinery	15	13
12	Sugarcane, excluding products of refineries	108	94
13	Boot and shoe cut stock and findings	71	62
14	Umbrellas, parasols, and canes	48	42
15	Lighting equipment	92	80
16	Hair work	40	35
17	Furs, dressed and dyed	89	77
18	Combs and hairpins, not made of metal or rubber	36	31
19	Mirror and picture frames	34	30
20	Leather goods, n. e. c.	33	29
21	Miscellaneous articles, n. e. c.		
22	Trunks, suitcases, and bags		
23	Liquors, rectified and blended		
24	House furnishings		
25	Jewelry and instrument cases		
26	Engraving (excluding steel, copperplate, or wood),		
27	Pocketbooks, purses, and card cases chasing, etching, and die sinking		
28	Gloves and mittens, leather		
29	Silverware and plated ware		
30	Rice cleaning and polishing		
31	Men's furnishing goods		
32	Bookbinding and blank-book making		
33	Boneblack, carbon black and lampblack		
34	China firing and decorating, not done in potteries		
35	Cardboard, not made in paper mills		
36	Optical goods		
37	Machine-tool accessories and machinists' precision tools and instruments		
38	Liquors, vinous		
39	Lithographing		
40	Turpentine and rosin		
41	Ink, printing		
42	Perfumes, cosmetics, and other toilet preparations		
43	Textile machines and parts		
44	Beauty shop equipment, excluding furniture		
45	Buttons		
46	Printing and publishing, books, music, and job		
47	Sewing machines and attachments		
48	Statuary and art goods (excluding concrete), factory production		
49	Silk manufactures		
50	Engraving, steel, copper plate and wood, and plate printing		
51	Cigarettes		
52	Card cutting and designing		
53	Photographic apparatus and materials and projection apparatus		
54	Instruments and apparatus, professional, scientific, commercial and industrial		
55	Electroplating		
56	Blacking, stains, and dressings		

SOURCE: See figure 90. The industries in this table are represented by dots below the lower dashed line.

TABLE 17.—*Fifty-six industries with greatest relative scatter (constituting top quintile of distribution relative to regression of number of counties on number of establishments), 1935*

[Listed in order of degree of departure from usual relationship, most unusual case first]

Rank	Chief location determinant [1] (M=material; C=consumer)	Industry	Average value added by manufacture per establishment	
			Thousands of dollars	Percentage of average for all industries
1	C	Gas, manufactured, illuminating and heating	478	416
2		Flour and other grain-mill products	63	55
3	C	Ice, manufactured	26	23
4	C	Beverages, nonalcoholic	31	27
5	M	Poultry dressing and packing, wholesale	29	25
6	M	Oil, cake and meal, cottonseed	60	52
7	C	Printing and publishing, newspaper and periodical	100	87
8		Railroad repair shops, steam	485	422
9		Clay products (excluding pottery) and nonclay refractories	68	59
10	C	Ice cream	44	38
11	M	Feeds, prepared, for animals and fowls	62	54
12	M	Condensed and evaporated milk	87	76
13	M	Butter	23	20
14		Agricultural implements, including tractors	630	548
15		Grease and tallow, excluding lubricating grease	69	60
16	M	Wood preserving	111	96
17		Cooperage	41	36
18		Carriages, wagons, sleighs and sleds	70	61
19	M	Planing mill products (including general millwork) made in planing mills not connected with sawmills	32	28
20	C	Foundries	128	111
21		Fertilizers		
22		Concrete products		
23		Cement		
24		Wood, turned and shaped, and other wooden goods, n. e. c.		
25		Boxes, wooden, excluding cigar boxes		
26	M	Vinegar and cider		
27	M	Lumber and timber products, n. e. c.		
28		Brooms		
29		Liquors, malt		
30		Saddlery, harness and whips		
31	M	Minerals and earths, ground or otherwise treated		
32	M	Sugar, beet		
33		Boiler shops		
34		Meat-packing, wholesale		
35	M	Lime		
36		Paper		
37		Explosives		
38		Caskets, coffins, burial cases, and other morticians' goods		
39	M	Pulp (wood and other fiber)		
40		Cordage and twine, jute goods, linen goods		
41		Engines, turbines, waterwheels and windmills		
42		Petroleum refining		
43	M	Canned and dried fruits and vegetables; canned and bottled juices; preserves; jellies, fruit butters, pickles and sauces		
44		Cereal preparations		
45	M	Marble, granite, slate, and other stone, cut and shaped		
46		Pottery, including porcelain ware		
47		Surgical and orthopedic appliances and related products		
48		Paving materials; blocks except brick and stone and mixtures		
49		Jewelry and instrument cases		
50		Sporting and athletic goods, except firearms and ammunition		
51		Fireworks and allied products		
52		Cars, electric and steam railroad, not built in railroad repair shops		
53		Washing machines, wringers, driers, and ironing machines for household use		
54		Men's cotton collars, nightwear, shirts, and work clothing		
55		Tobacco, chewing, smoking, and snuff		
56	M	Wood distillation and charcoal manufacture		

SOURCE: See figure 90. The industries in this table are represented by dots above the upper dashed line.

[1] Classification of locational determinants according to Gardiner C. Means and Grace W. Knott, in National Resources Committee, *The Structure of the American Economy* 1939, part I, appendix 8, pp. 264–269.

Branch plants may or may not exist, depending on whether the size of individual plants is limited by the problem of management or by other factors.

Characteristically the plants in clustered industries are small. Among the first 20 of the industries listed in table 16, only one, watch cases, showed an average value added by manufacture per establishment as great as the average for industry as a whole. For this group of 20 industries taken together, the average annual value added by manufacture was about $59,000 per establishment, as compared to $136,000 for those industries ranked as intermediate in degree of cluster.[22]

It is worth noting that most of the highly clustered industries in 1935 were highly concentrated in one or two industrial areas. For instance, 93 percent of the establishments in the feathers industry were in the New York City industrial area. The same area had 86 percent of the fur-goods establishments, 83 percent of those making embroideries, etc., and 70 percent of those in women's and children's apparel not elsewhere classified. The Providence industrial area had 71 percent of all the establishments in the jewelers' findings and materials industry.

The characteristics which make for this type of location may be summarized briefly. The products are highly individualized and produced for an unstable market of buyers who "shop" before they buy. Actual transportation costs are unimportant, making it possible for the bulk of the output to be distributed through one or two metropolitan markets. The labor requirements are relatively specialized and skilled, with an unusually high percentage of women and considerable seasonal fluctuation in employment. The lack of product standardization, which keeps plants and firms small, at the same time provides an incentive to localization in metropolitan areas for the sake of labor supply and services required in connection with production and marketing. Such plants as are found detached from the main clusters are generally devoted to the more staple branches of the industry. They are thus less dependent on intimate contact with market and skilled labor supply. They are likely to be more fully mechanized and integrated, due to the more uniform nature of their product and the absence of auxiliary industries in the immediate vicinity; hence these isolated plants are likely to be larger.

A good illustration of this last point is the shoe industry. As table 18 shows, the average size of shoe factories is consistently smaller in each of the major industrial areas than in the State including the area. For example, in the New York industrial area the average size of shoe factories in 1937 was 81 wage earners, and in the Rochester industrial area it was 177; while in the remainder of the States of New York and New Jersey the average size was 371 wage earners. Such differences apply in regard to practically all important shoe-production centers.

TABLE 18.—*Average number of wage earners per shoe factory in principal shoe-producing industrial areas and in remainders of States in which those areas are located, 1937*

Industrial area or State	Number of establishments	Wage earners: Total	Wage earners: Average per establishment
Boston	219	28,276	129
Worcester	32	8,593	268
Remainder of Massachusetts	43	9,851	229
New York	177	14,420	81
Rochester	15	2,660	177
Remainder of New York and New Jersey	51	18,929	371
St. Louis	21	8,377	396
Remainder of Missouri and Illinois (less city of Chicago)	67	30,007	450
Chicago	32	4,388	137
Remainder of Illinois and Indiana	38	14,207	374
Milwaukee	25	4,380	175
Remainder of Wisconsin	29	5,685	196
Cincinnati	10	3,168	317
Remainder of Ohio and Kentucky	30	13,049	435
Philadelphia	24	2,091	87
Allentown-Bethlehem	3	185	62
Remainder of Pennsylvania and New Jersey	85	13,002	153
Baltimore	8	898	112
Remainder of Maryland	4	1,739	435
Above 11 industrial areas	566	77,436	137
Above 11 States, excluding specified industrial areas	292	91,759	314

SOURCE: Census of Manufactures, 1937. Averages calculated. The 11 industrial areas shown here include all those for which data for the shoe industry could be published without disclosure of the operations of individual establishments.

A similar case is that of the men's and women's clothing industries not elsewhere classified, including both regular and contract factories. In the New York City industrial area in 1937 this group had an average of 36 wage earners per establishment, as compared with 78 per establishment for the remainder of the United States.[23]

Industries With Scattered Plants

A contrasting type of geographical distribution is shown by the "scattered" industries listed in table 17. In this type of industry, the product is relatively staple (not necessarily standardized) and consequently the concentration of the industry at any one point is determined primarily by the availability of materials or markets in the vicinity. The location of such an industry is dominated generally by transport cost.

The positive economies of any concentration relative to materials or markets are very limited. If material assembly costs are the preponderant factor, these can be minimized by locating the industry in fairly close conformity with the distribution of materials.[24] On the other hand, if delivery costs on the product are

[22] Table 19, below.

[23] Calculated from data in Census of Manufactures, 1937.

[24] The existence of water transport routes, of course, makes it feasible to ship even relatively bulky materials considerable distances.

TABLE 19.—*Comparative average size of establishments in exceptionally clustered industries, exceptionally scattered industries, and other industries, 1935*

	Value added by manufacture (thousands of dollars)	Establishments	Value added per establishment (thousands of dollars)
Total, all industries	19,496,269	169,111	115
20 industries with greatest relative cluster [1]	1,092,574	18,698	59
20 industries with greatest relative scatter [2]	2,534,647	33,583	76
All other industries	15,869,048	116,830	136

SOURCE: Census of Manufactures, 1935.

[1] Comprising the first 20 industries listed in table 16 above.
[2] Comprising the first 20 industries listed in table 17 above.

preponderant, these can be minimized by locating the industry in fairly close conformity with the distribution of markets. Where the product is staple, there is likely to be relatively little of the "funneling" of distribution through a few major markets which characterizes the type of industry first considered.

The extent to which the industry's location resembles that of materials or markets is limited by the dependence of costs upon the size of plant. This, of course, imposes no upper limit to the degree of concentration in important material or market areas; in such places, many plants can operate side by side. But the higher costs of smaller plants do impose a definite minimum limit to localization. The fairly complete dispersion which would be necessary in order to minimize transport costs is likely to be impracticable in areas of sparse markets or material supply.

Characteristically the plants in highly scattered industries are small. Table 19 shows that for the 20 industries ranking as most scattered the average value added by manufacture per establishment was only about $76,000, as compared with $136,000 for all industries except the 20 most scattered and the 20 most clustered. Out of the 20 most scattered industries only 4 (gas works, steam railroad repair shops, agricultural implements, and foundries)[25] showed an average value added as great as that for industry as a whole. The other 16 were all smaller.

It appears then that smaller plants are characteristic of both extreme locational types of industry—the very scattered and the very clustered—while large-scale production is associated with an intermediate degree of scatter or cluster.[26]

[25] The first two of these are no longer classified as manufacturing industries by the Census.

[26] A similar observation was made by Prof. P. Sargant Florence in his presidential address before Section F of the British Association, Nottingham, 1937. See "Economic Research and Industrial Policy", in *Economic Journal*, Vol. XLVII: 188 (December 1937), p. 629.

Material-oriented industries.—In an industry of this scattered type located primarily with reference to materials, the geographic pattern has the following characteristics:

1. So far as major producing areas at least are concerned, the industry is distributed in fairly close proportion to the distribution of the materials. The larger centers of production are likely to have several plants each.

2. A single firm will often operate several plants, in the same or in different areas.

3. At less important "collecting points" for materials there is generally just one plant. Most of these plants are smaller than the ones in the major centers, and in general their size will vary with the density of local supply of materials.

4. A certain fairly definite minimum size of plant may appear. Each isolated plant must draw from a sufficiently large supply area to maintain at least this minimum scale; and within an area furnishing this quantity of material there will ordinarily be one plant. However, because of differences in the density of market demand, in labor costs, and in types and costs of power available, minimum plant size may vary from area to area.

5. At locations furnishing less than the above minimum supply the industry is not represented at all.

Different material-oriented industries will, of course, differ widely in the degree to which their orientation toward materials is modified by the economies or exigencies of large-scale production. In table 20 are listed 31 manufacturing industries which according to Means and Knott[27] are located primarily with reference to access to raw materials. These fall into four groups, devoted to the processing of minerals, forest products, vegetable products, and animal products, respectively. Within each group are large and small industries, and a wide range of plant sizes.

Probably the best measure of the "typical" size of plant in an industry, when any typical size exists at all, is the weighted median number of wage earners. In any industry the "weighted median" plant is of such size that half the wage earners in the industry are employed in smaller plants and half the wage earners are employed in larger plants. This measure can be fairly closely approximated by interpolations in the tabulation of manufacturing plants by number of wage earners recently issued for 1937 by the *Census of Manufactures;* and for the purpose of a rough average of size it appears adequate. Such medians, for the

[27] National Resources Committee, *Structure of the American Economy*, 1939, part 1, appendix 8, table I, pp. 265–269.

TABLE 20.—*Size characteristics of establishments in selected industries located primarily with reference to materials, 1939*

Industry	Number of establishments	Number of wage earners	Median (wage earners)	Lowest decile size (Wage earners)	Lowest decile size (Ratio to total number of wage earners)	Quartile coefficient
Processing of minerals:						
Primary smelting and refining of nonferrous metals	63	27,630	750.0	202.8	*Percent* 0.73	*Percent* 56.2
Gypsum products	68	4,936	144.3	42.0	.85	38.5
Salt	40	3,737	201.2	40.2	1.08	57.8
Lime	269	9,458	77.0	16.5	.17	64.1
Bone black, carbon black, etc.	53	1,574	38.4	15.5	.98	34.6
Minerals and earth, etc.	237	5,858	44.9	10.7	18	67.6
Monuments, tombstones, cut-stone, etc.	1,244	18,516	43.0	5.7	.03	74.1
Processing of forest products:						
Pulp mills	194	26,870	243.6	69.7	26	50.3
Wood naval stores	25	2,353	227.0	40.6	1.73	43.7
Wood preserving	218	11,242	85.4	29.3	.26	47.6
Hardwood distillation and charcoal	43	1,770	119.7	18.2	1.03	62.8
Wood products, not elsewhere classified	886	21,993	60.8	10.8	.05	69.2
Planing mills	3,076	62,838	48.9	8.8	01	79.5
Excelsior	53	925	26.5	7.8	.84	44.7
Gum naval stores	755	971	3.7	1.1	11	43.2
Processing of vegetable products, etc.:						
Sugar refining, cane	27	14,133	765.0	290.3	2.05	33.1
Corn sirup, corn sugar, etc.	35	6,764	659.5	137.6	2.03	55.3
Beet sugar	85	10,410	153.2	72.3	.69	31.8
Linseed oil, cake, and meal	25	2,120	134.4	51.8	2.44	41.0
Cane sugar, except refineries	78	4,217	70.3	27.0	.64	43.4
Canned and dried fruit and vegetables, etc.	2,007	98,022	132.6	20.2	.02	75.9
Rice cleaning and polishing	72	2,346	48.8	18.4	.78	41.9
Cottonseed oil, cake, and meal	447	15,191	46.6	17.3	.11	44.7
Malt	52	1,459	49.5	13.3	.91	55.0
Prepared feeds for animal and fowl	1,383	15,401	32.5	4.4	.03	73.7
Wines	301	2,056	17.1	3.4	.17	68.0
Vinegar and cider	132	1,059	14.8	3.3	.31	54.8
Processing of animal products:						
Poultry dressing and packing, wholesale	765	14,506	39.9	9.0	.06	57.6
Condensed and evaporated milk	562	9,705	37.97	8.8	.09	50.8
Butter, creamery	3,506	17,953	12.2	1.9	.01	75.4
Cheese	2,682	5,009	4.6	1.3	.03	69.6

SOURCE: Calculated from data in Census of Manufactures, *Summary of Establishments Classified as to Size by Number of Wage Earners, 1939*, November 1941.

31 industries in the "material-oriented" group, are given in table 20.

However, within any single industry there is always considerable size variation, some of which, as has been indicated, is quite definitely related to location. To take an extreme example, in the "planing mills" industry the (weighted) median size in 1939 was about 49 wage earners; but a quarter of the wage earners of the industry were in plants employing 19 or fewer, and another quarter were in plants employing 167 or more. A rough measure of the relative variability of size is the quartile coefficient, which is the ratio of the difference of the third and first quartiles to their sum. In the "planing mill" industry the quartiles given above yield a quartile coefficient of 79.5 percent, which is higher than that of any other industry in the material-oriented group and thus indicates relatively great heterogeneity as to size. By contrast, there also appears in the group the "cane sugar refining" industry, with the low coefficient of 33.1 percent. Half the wage earners in this industry were in plants ranging from 523 to 1,040 wage earners.[28]

From the locational point of view, the most significant aspect of plant size is the minimum rather than any type of average. In every industry, however, there are certain establishments reporting few wage earners or none, for various special reasons. Consequently, it seems preferable, in gauging the relative minimum plant sizes in various industries, to disregard the 10 percent of the wage earners employed in the smallest establishments. The resulting size measure, known as the "lowest decile," is likewise tabulated in table 20. In general, of course, the industries with larger median size have larger deciles; but a few cases are conspicuously out of line in this regard. Thus the "linseed oil, cake, and meal" and the "canned and dried fruits and vegetables" industries have about the same median size, but the lowest decile is 52 wage earners for the former industry and 20 for the latter. It would appear then that some branches of the "canned and dried fruits and vegetables" industry can operate on a much smaller scale than is feasible in "linseed oil, cake, and meal."[29]

Plans involving dispersed locations for industry should take into account these variations in "minimum" size, which set limits upon the closeness with which an industry can conform to the location of scattered material sources.

Some further light is shed by the next to last column of table 20, where the lowest decile or "minimum" number of wage earners is expressed as a percentage of the total number of wage earners employed in the industry. This percentage shows the extent to which the industry is restricted in number of locations by the lower limit on size. For example, in the "planing mill" industry the lowest decile is about the same as in "excelsior manufacturing". However, this "minimum"

[28] Another way of measuring the degree of variation in size of plants in an industry is the "index of concentration" used in the Thorp and others, *op. cit.*, pt. I, chs. III–IV. This index appears in two forms: (*a*) the number of establishments, and (*b*) the percentage of all establishments, required to account for half the wage earners in the industry. If all plants had the same number of wage earners, it would of course require exactly half the plants to account for half the total wage earners. In any actual industry, plant sizes are unequal, so fewer than half of the plants employ half the wage earners.

[29] Census data cannot provide exact conclusions concerning minimum plant size because:

(*a*) Even establishments not in the lowest decile may not realize profits. And even if each biennial census should present the same general picture, that picture might be due merely to the presence of the same number of small establishments, rather than to the presence of the same small establishments. Investigations in some mercantile fields have revealed a high turnover of small firms.

(*b*) The smallest plants (even when the lowest decile is omitted) may experience an average level of employment somewhat higher than the specific level of employment which the census figures reveal. Differences in the timing of firms' sales fluctuations may cause different firms to show the lowest employment totals in different census records. This source of error, however, is probably not very important.

constitutes only 0.01 percent of the total number of wage earners in planing mills. In other words each establishment, to be of minimum size, must constitute about 0.01 percent of the industry (as measured by employment). On this basis there would be room for 10,000 establishments in the country (actually there were 3,076); so it cannot be said that the requirement of minimum size is very restrictive of location. By contrast, the minimum in "excelsior manufacturing" constitutes 0.84 percent of the industry's total employment. If each plant were just of minimum size there would thus be only 119 plants in the country. Actually since most plants were larger, they numbered only 53. This is a case, then, in which economies of plant size may really impose an important restriction on the location of the industry with respect to its raw-material sources.

Market-oriented industries.—The other class of transport-dominated industries comprises those located primarily with reference to markets, and presents the following characteristics of geographic distribution:

1. So far as major consuming centers are concerned, the industry is distributed in fairly close proportion to markets. The larger centers of production are likely to have several plants each.

2. A single firm may operate several plants, in the same or different areas.

3. At less important distributing points, there is generally just one plant. Most of these plants are smaller than the ones located at major markets, and in general their size will vary with the density of local supply of materials.

4. A certain fairly definite minimum size of plant may appear. Each isolated plant must serve a sufficiently large market area to maintain this minimum scale; and within an area consuming this quantity of the product, there will most often be but one plant.

5. At market points with a demand less than this minimum, the industry is not represented at all. Such markets if served at all are served from other points.

Table 21 gives for 14 selected market-oriented industries the same size characteristics already set forth in table 20 for material-oriented industries. In general, rather greater variations in size appear here as among the plants in a given industry: the quartile coefficients range from 52.8 percent for compressed and liquefied gas plants to 90.2 percent for "newspapers, publishing and printing," the difference probably evidencing more extensive advantages of size in the latter business. Another noteworthy fact in table 21 is that the ratio of lowest decile plant size to total wage earners runs very low, rising only to 0.20 percent in stereotyping and electrotyping and still less than that in all the rest. This means that in none of the industries cited is it apparently necessary for a small plant to have more than a small fraction of 1 percent of the national market in order to be big enough to survive.

TABLE 21.—*Size characteristics of establishments in selected industries located primarily with reference to markets, 1939*

Industry	Number of establishments	Number of wage earners	Median (wage earners)	Lowest decile size: Wage earners	Lowest decile size: Ratio to total number of wage earners	Quartile coefficient
					Percent	*Percent*
Oray-iron and semisteel castings	1, 161	58, 428	99. 2	23. 1	0. 04	65. 4
Lithographing and photolithographing	749	26, 000	109. 1	15. 2	. 06	70. 0
Periodicals, publisbing, and printing	600	20. 985	192. 3	15. 1	. 07	86. 3
Machine-shop products, n. e. c.	2, 125	60, 717	146. 3	12. 1	. 02	84. 2
Bookbinding and related industries	1, 133	25, 690	86. 0	9. 5	. 04	83. 1
Electrotyping and stereotyping	234	4, 412	36. 5	8. 3	. 19	72. 0
Photoengraving, not done in printing establishments	694	9, 207	25. 5	6. 1	. 07	63. 7
Compressed and liquefied gases	379	3, 960	16. 6	5. 3	. 13	52. 8
Engraving (steel, copper plate, and wood plate printing	436	5, 353	36. 7	4. 6	. 09	80 1
Signs, advertising displays, and advertising novelties	1, 386	17, 206	38. 8	4. 5	. 03	74. 2
Newspapers, publishing, and printing	6, 878	96, 991	85. 9	4. 3	. 004	90. 2
Ice cream and ices	2, 734	15, 711	14. 5	2. 3	. 01	76. 6
Nonalcoholic beverages	4, 504	21, 265	9. 3	1. 7	. 01	63. 4
Ice, manufactured	3, 975	15, 912	5. 3	1. 5	. 01	66. 1

SOURCE: Calculated from data in Census of Manufactures, *Summary of Establishments Classified as to Size by Number of Wage Earners, 1939, November 1941.*

TABLE 22.—*Average number of wage earners per ice cream factory in principal industrial areas and in remainder of States in which those areas are located, 1937*

Industrial area or State	Number of establishments	Wage earners: Total	Wage earners: Average per establishment
New York	160	1, 735	10. 8
Remainder of New York State and New Jersey	179	868	4. 8
Chicago	61	878	14. 4
Remainder of Illinois and Indiana	162	899	5. 5
Philadelphia	47	774	16. 4
Pittsburgh	36	432	12. 0
Remainder of Pennsylvania and New Jersey	254	1, 434	5. 7
Los Angeles	90	597	6. 6
San Francisco	62	219	3. 5
Remainder of California	133	362	2. 7
Boston	74	495	6. 7
Remainder of Massachusetts	49	285	5. 8
Detroit	64	400	6. 3
Remainder of Michigan	108	414	3. 8
St. Louis	26	262	10 1
Remainder of Missouri and Illinois (less city of Chicago)	177	1, 091	6. 2
Cleveland	28	228	8. 2
Remainder of Ohio	125	945	7. 6
Baltimore	26	205	7. 9
Remainder of Maryland	17	73	4. 3
Above 11 industrial areas	674	6, 225	9. 2
Above 11 States, excluding specified industrial areas	986	5, 158	5. 2

SOURCE: Census of Manufactures, 1937. Averages calculated.

In both the material-oriented and the market-oriented types of transport-dominated industries, it has been noted that the size of individual plants would be expected to be larger in the areas of more intensive production. This is in direct contrast to the situation exemplified by the shoe industry in table 18 above. As an illustration of the correlation between size of

plant and concentration of production in a transport-dominated industry of the market-oriented type, table 22 presents the average size of establishments in the ice cream industry, in each of the most important industrial areas and in the State including the area. In every instance, the industrial area itself (i. e., the district of more concentrated demand and more concentrated production) had larger factories than the rest of the State or States including the area.

Conclusion

This chapter has analyzed the factors which govern the optimum size of plants, firms, and production centers for an industry. Some explanation has been given for the wide diversity which exists in the actual sizes of these units, and for some characteristic types of industry location patterns.

Insofar as generalization is possible at all, it can be said that the size of manufacturing plants has been rather steadily increasing. The fact that this trend is due largely to the growing relative importance of industries in which large plants are the rule does not alter the basic locational implications of this trend, which are clearly in the direction of geographic concentration. The way in which the economies of large-scale production limit the adjustment of industry to scattered material sources, labor supply, and markets has been analyzed in the present chapter.

The size of firm likewise appears to be on the increase though in this case it would be misleading to refer to the "economies" of large-scale control without recognizing other motives of perhaps even greater practical significance. The strictly locational implications of increased concentration of control are perhaps relatively incidental to the broader questions which this trend raises.

What has here been referred to as the "size of production centers" will be analyzed further in a later volume of this report, under the headings of localization and urbanization. The existence of a trend is more doubtful in this case. Some areas and some industries have experienced increasing geographic concentration of industry, and others the reverse.

These trends, of course, indicate only historical facts. An evaluation for policy purposes must rest on careful analysis of the character of the economies, social and private, which motivate the growth or decline of industrial concentration.

The fundamental conclusion is that no one can understand (to say nothing of guiding or planning) the location of an industry merely on the basis of its "production requirements" of labor, materials, access to markets, and the like. The variations in efficiency associated with size of plants, firms, and production centers are vital in determining location and must be taken into account. In practice they are taken into account, but rarely by the same people. An operating man thinks of location in terms of plants; an executive thinks of the firm; governmental and utility officials and "planners" are more likely to think of a community or region as a unit. To each, "efficiency" has a different meaning. The plant manager or engineer may be thinking of low production costs; the firm executive, of competitive strategy and security; while community or public interests are served by points of view transcending both of these and embracing the ultimate welfare of the local or national economy. Since all three points of view are essential parts of our present organization, all must be recognized in an over-all analysis of industrial location such as this report attempts.

CHAPTER 15. INTEGRATION OF PROCESSES IN PLANT, CONCERN, AND PRODUCTION CENTER

By Edgar M. Hoover, Jr.*

The present chapter deals with the scope rather than the scale of production units—the question of what different processes lend themselves to combination in the same plant, the same firm, or the same location—and the resulting effect upon location patterns. The treatment of this question of scope naturally follows lines similar to the discussion of size in the previous chapter. That is, the various basic economies and diseconomies of extensions of scope will be set forth and their interactions explored. Some effort will be made to indicate which factors are dominant in particular instances, and what trends may be expected.

This question is, however, more intricate than that of size. There is no single measuring rod for the qualitative coverage or scope of a plant, firm, or production center, and the possible directions of extension of scope are many. Furthermore, there is here an almost complete lack of comprehensive statistical material with locational significance.

The term "integration" is customarily used in a rather loose way. In a narrow sense it applies to the combination of successive stages of manufacture within a single plant; but sometimes it is used to describe the combining of otherwise related products or processes in the same plant, and often it refers to the operation of various related types of plants by a single firm. In the present discussion, a more precise terminology is required. A distinction must be made according to whether the processes are combined in a single plant or a single firm or merely the same geographical location; and the several possible types of process relations must likewise be distinguished.

Unit of Integration

Integration of operations may take place within any of the four kinds of organizational units, as follows:

1. Firm integration: Related processes within the same firm, but in different plants.
   (*a*) At the same location.
   (*b*) At different locations.
2. Locational integration: Related processes at the same location (i. e., "production center"), but in different firms.
3. Plant integration: Related processes within the same plant (and hence in the same firm and location).

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The only comprehensive studies of integration of manufacturing operations deal with firm integration exclusively and fail to distinguish between its two subcategories. *The Structure of Industry*[1] is based on Census of Manufactures schedules, on which each plant or establishment has been classified according to the industry in which the bulk of its production falls. The study thus gives some indication of the extent to which plants with the same or different predominant products are operated by single central offices. It does not, however, throw any light on the integration of related processes within plants nor on "locational integration" (the juxtaposition of related processes in the same production center). An earlier Census Bureau monograph is similarly limited.[2]

Firm Integration

The combining of different types of product within firms can be approximately measured on the basis of census data. In 1937, 8.6 percent of all manufacturing establishments were operated by multi-industry firms (i. e., those having plants in two or more different census industries). These establishments, being of much greater average size than others, employed 39.2 percent of all manufacturing wage earners and accounted for 45.3 percent of the total value added by manufacture in American industry.[3]

The relative importance of firm integration in different branches of industry has been measured in the TNEC monograph in a somewhat different manner, with each central office and all its establishments assigned to the industry group in which the bulk of the firm's output was classified. Although the difference in classifications makes impossible any precise

[1] Willard L. Thorp and others, Temporary National Economic Committee, Monograph No. 27, 1941.

[2] Willard L. Thorp, *The Integration of Industrial Operations,* Census Monograph III, 1924.

[3] Calculated from data in *Census of Manufactures,* 1937, and in Thorp and others, *The Structure of Industry,* TNEC Mono. No. 27, p. 161. A census industry often covers a considerable variety of different products—for example, "Chemicals not elsewhere classified." In recent years the census has distinguished about 4,000 products and about 400 industries. Since there are about 160,000 census establishments, the average census industry could be thought of as comprising 10 products produced in 400 establishments all told, or 40 establishments per product. Needless to say, there is no such real industry.

measure,[4] one may conclude from table 1 that the relative importance of firm integration is probably greatest in the petroleum and coal products group, with about half the establishments belonging to multi-industry firms. In the chemicals, paper, and transportation equipment groups firm integration is also relatively important; its importance is least in the printing and publishing, nonferrous metals, forest products and textile groups.

TABLE 1.—*Manufacturing establishments operated by multi-industry*[1] *central offices, by industry groups, 1937*

Industry groups	Establishments in specified industry group		Establishments (in all industry groups) operated by central offices classified in specified industry group		Approximate percentage of all establishments in industry group operated by multi-industry central offices[2]
	Total	Operated by central offices	Total	Operated by multi-industry central offices	
All manufacturing	166,794	25,699	25,699	11,378	9
Products of petroleum and coal	675	326	430	345	51
Chemicals and allied products	7,419	2,348	2,229	1,649	22
Paper and allied products	3,053	960	886	676	22
Transportation equipment, air, land and water	1,942	459	561	426	22
Rubber products	478	110	115	83	17
Iron and steel and their products, excluding machinery	8,345	1,519	1,620	1,295	16
Food and kindred products	48,727	9,267	9,546	4,695	10
Machinery, excluding transportation equipment	9,961	1,435	1,429	958	10
Leather and its manufactures	3,364	503	499	287	9
Stone, clay, and glass products	6,071	1,325	1,316	500	8
Textiles and their products	20,616	2,703	2,671	1,317	6
Forest products	18,012	2,516	2,305	1,124	6
Nonferrous metals and their products	5,303	470	394	268	5
Printing, publishing and allied industries	22,751	905	817	324	1
Miscellaneous industries	10,077	853	881	431	4

SOURCE: Based on data from Willard L. Thorp and others, *The Structure of Industry*, Temporary National Economic Committee, Monograph No. 27, 1941, table 2, p. 114; table 3, p. 116; and table 17, p. 154. Percentages calculated.

[1] Multi-industry central offices (called "complex" by Thorp and others), are those operating establishments in more than one of the 351 industry classifications used by the 1937 Census of Manufactures.

[2] These percentages for the separate industry groups are subject to some error, since they are based on the number of establishments (of all kinds) operated by central offices classed in the specified industry group, divided by the total number of establishments in the specified industry group; that is, the fourth column in the table divided by the first. A comparison of the figures in the second and third columns gives an idea of the degree of error introduced by this discrepancy in classification.

As table 2 shows, nearly two-thirds of all central offices (accounting for nearly half the establishments) operated established in only a single census industry, while another quarter of the central-office companies operated establishments in two different census industries. However, two companies had extended their operations into 20 or more industries each.

TABLE 2.—*Distribution of central-office companies according to number of manufacturing industries in which establishments are operated, 1937*

Number of industries	Central offices			Establishments		
	Number	Percentage of total	Cumulative percentage	Number	Percentage of total	Cumulative percentage
Total	5,625	100.0	100.0	25,699	100.0	100.0
1	3,574	63.5	63.5	11,321	44.1	44.1
2	1,413	25.1	88.6	5,327	20.7	64.8
3	343	6.1	94.7	2,252	8.8	73.6
4–5	190	3.4	98.1	2,122	8.3	81.9
6–7	45	.8	98.9	1,077	4.2	86.1
8–9	26	.5	99.4	855	3.3	89.4
10–14	23	.4	99.8	1,349	5.2	94.6
15–19	9	.2	[1] 100.0	1,015	3.9	98.5
20 and over	2	([2])	100.0	380	1.5	100.0

SOURCE: Thorp and others, *op. cit.*, table 6, pp. 123–124.

[1] More than 99.95 percent.
[2] Less than 0.05 percent.

No one has verified statistically the common impression that firm integration has been increasing in relative importance. The TNEC monograph already cited indicates that central-office operations as a whole increased their share of total manufacturing wage earners from 48 percent in 1929 to 51 percent in 1937,[5] but it is not known whether the same trend applies to multi-industry central offices.

Locational Integration

The concept of integration of processes at a common production center is less clear-cut than the concepts of firm or plant integration, because a production center is less strictly definable than either a plant or a firm. Generally there is no doubt as to whether or not two processes are actually being carried on in the same firm, or the same plant; but if one process is being carried on, for example, in New York City and the other in Newark, there may well be room for doubt as to whether these should be regarded as two production centers or one.

Statistical measurement of the degree to which related processes are locationally juxtaposed, or integrated, involves the measurement of the degree of "linkage," explained and illustrated in chapter 5 of this report. Given the requisite basic data, measures of linkage can be adapted to any definition of "production center" which may be thought suitable for the purpose in hand. The county and the "industrial area" are perhaps the most generally appropriate geographical units, being especially convenient in connection with census data.

[4] The difficulty is that branch establishments are classified in some of the tabulations (as in the second column of table 1) according to the census industry to which the establishment itself belongs, while in other tabulations (as in the third column of table 1) they are classified according to the census industry in which their *central office* (on the basis of predominance of value of products) belongs. Thus, referring to table 1, we find 326 branch plants in the petroleum and coal products industry group, some of which probably were operated by central offices classified in other groups. The number of establishments operated by all of the petroleum-and-coal group control offices was 430, but some of these establishments belonged in other industry groups.

[5] Thorp and others, *op. cit.*, p. 111, and note 1.

Plant Integration

Data regarding the extent of combination of products within single plants are scarce, but a tabulation based on census records for the 50 concerns with largest value of manufactured products in 1937 gives at least a rough picture (see table 3). These concerns operated 2,869 establishments which manufactured 2,043 distinct census products. As shown in table 3, about one-fourth of the establishments produced only one product each, and three-fourths produced fewer than six different products each.[6]

Considerable caution should, of course, be exercised in extending the results of this particular sample to the entire field of manufacturing. The establishments operated by the largest firms are probably not typical with regard to their degree of integration, although it is not known whether they are more or less integrated in their internal operations.

TABLE 3.—*Distribution of establishments maintained by the largest 50 manufacturing companies, according to the number of products manufactured in each establishment, 1937*

Number of products per establishment	Establishments: Number	Cumulative number	Cumulative percentage
1	735	735	25.6
2	562	1,297	45.2
3	372	1,669	58.2
4	280	1,949	67.9
5	201	2,150	74.9
6–10	395	2,545	88.7
11–15	124	2,669	93.0
16–20	65	2,734	95.3
21–25	55	2,789	97.2
26–30	27	2,816	98.2
31–35	23	2,839	99.0
36–40	15	2,854	99.5
41–45	7	2,861	99.7
46–50	4	2,865	99.9
51 and over [1]	4	2,869	100.0

SOURCE: Thorp and others, *op. cit.*, table 2–c, pp. 716–717.

[1] The largest number of products reported for any single establishment was 88.

Types of Integration

As already said, the range of possible types of product or process relationship which may provide a basis for integration is practically limitless. Merely for convenience in discussion, however, it is desirable to reduce these types of relation to some classification.

The classification used by the TNEC monograph on the structure of industry runs, with certain revisions, as follows:[7]

A. Diverging functions:

1. Products from the same material:
   (*a*) Alternate products of the same material (e. g., butter and cheese).
   (*b*) Byproducts of the same material (e. g., cotton and cotton seed).

2. Similar or complementary production requirements or techniques:
   (*a*) Similar production requirements or techniques ("like processes" in TNEC study; e. g., spinning cotton and spinning wool).
   (*b*) Complementary use of production factors (e. g., coal mines and silk mills employing male and female labor respectively).

B. Convergent functions:

1. Complementary production (goods or services for the same immediate market):
   (*a*) Production of complementary materials, to undergo transformation in a subsequent process (e. g., malt and yeast).
   (*b*) Production of complementary parts, entering into a subsequent assembling process (e. g., automobile bodies and frames).
   (*c*) Production of complementary finished goods brought together at the final stage before distribution (e. g., containers and the goods contained therein).
   (*d*) Complementary industries (primarily manufacturing activities carried on by concerns mainly devoted to nonmanufacturing; e. g., wood-preserving plants operated by railroad companies).

2. Auxiliary production, assisting in the production of an article without adding physically to it.
   (*a*) Auxiliary services (e. g., repair shops).
   (*b*) Auxiliary commodities (e. g., ice for ice cream plants).

3. Dissimilar products for like markets (converging in the market place after manufacture; e. g., ice cream and nonalcoholic beverages).

C. Successive functions (vertical integration; e. g., spinning and weaving).

D. Unrelated functions (e. g., linseed oil and foundry supplies).

Tables 4 and 5 are inserted to show approximately the relative importance of these different types of integration among central offices in the several industry groups. It should be kept in mind, however, that these tables are concerned only with firm integration in the sense of the operation by one office of two or

[6] Since these figures measure plant integration in terms of number of products, they are not comparable with those in other tables, based on number of census industries. A census industry may include a dozen or more different census products.

[7] Thorp and others, *op. cit.*, pp. 146ff. The TNEC first type, "uniform functions," is omitted here since it refers to the scale of production of a single commodity, as already discussed in chapter 14. The TNEC term "joint products" has here been changed to "alternative products" in order to make clear the distinction between these and byproducts. Classification A–2–b (complementary use of production factors) has been added for the sake of completeness, though not recognized in the TNEC tabulation.

more establishments classified in different Census industries.

The demarcations among types are, of course, not precise, and many actual instances of integration are combinations of 2 or more of the 12 types here enumerated. Theoretically at least, each of these types of relationship may provide a basis for integration within any of the 4 organizational units previously discussed: i. e., within a firm (at the same or different locations), at a location, or in a plant. There are thus 48 possible "simple" forms of integration, and practically an infinite number of combinations. The discussion which follows here is merely to point out the locational high lights of the major forms of integration.

Divergent Functions

Divergent processes convert the same material into two or more different products. It goes almost without saying that processes using the same material are likely to show a similarity of locational pattern if the material in question is very bulky or expensive to transport. However, this similarity does not necessarily imply any genuine economies of integration between the processes involved, since each might locate near the source of a dominant material regardless of whether the other did or not. A significant relation exists only if the use of material in one process either encourages or discourages the use of the same material in another process in the same plant, firm, or location.

In some cases, there is a choice of processes and products, as for instance in the conversion of aluminum into sheet or cable form, and the products may correctly be described as "alternative,"[8] since any given unit of their common material may be used for either but not both. In other cases, however, the process consists essentially of separating a complex material into more homogeneous constituents, and the various products must emerge together in more or less fixed proportions. This is the case, for example, in the ginning of cotton, and in all cases where "byproducts" are referred to. Quite commonly, both "alternative" and the "byproduct" combinations coexist in connection with the same material and the resulting array of product possibilities is quite complex. Thus in refining petroleum there is a great latitude in determining the relative yields of the more important products, and yet whatever choice is made will yield also some combination of byproducts. For the sake of simplicity alone it is justifiable to separate the two types of relation.

Alternative Products of the Same Material

The economies of processing the same material into alternative products in a single plant are primarily those of mass purchasing and handling. Larger-scale buying brings better terms, and larger-scale handling decreases the unit cost of this operation, so that enlarging the scope of the plant may be one way of obtaining large-scale economies in these initial stages. Thus whenever the optimum scale of operation for the initial processes is greater than that for the subsequent processes, the natural result is integration of several products from one material.

In addition there is the likelihood that the fluctuations in demand for the various products will not be perfectly synchronous; so the additional advantage of more regular purchasing and materials-handling is obtainable. In the converted-paper industries, for instance, a large number of seasonal lines are commonly produced together with some regularization of production as a result.

Examples of combination of divergent functions in single plants can readily be found. The following descriptions of the products of individual Milwaukee factories, from a recent directory of Wisconsin manufactures, are suggestive:[9]

Iron and steel products.
Sheet metal products.
Plastic handles, boxes, electrical instrument parts, automobile hardware, clock housings, condiment sets, pulleys, etc.
Butter, cheese, ice cream, milk.

Not all of the advantage of integration arises from the use of a common raw material, even in the cases cited above. The use of similar equipment and processes is doubtless very important in determining the scope of the sheet metal and plastic-goods manufactures, and in the case of the dairy products there is a common market as well.

At a production location as distinct from an individual plant, there are likewise certain characteristic advantages in using the same material in different ways. A larger total demand for the material is quite likely to result in cheaper supply up to a certain point, and certainly in better organization of marketing and handling. The additional factor of regularization of demand for the material by juxtaposition of divergent uses brings to the producing center as a whole a further possible economy, which normally will be reflected in lower material costs or more dependable supply to the individual plants at that location.

[8] Thorp and others refer to this relationship as "joint products" (*op. cit.*, p. 147). Such terminology is highly confusing in view of the prevailing use of the term "joint products" to cover commodities which emerge from a process in fixed relative quantities. This latter case is *Large, Medium-Sized, and Small Business*, Temporary National Economic designated herein, and in the TNEC monograph, by the term "byproducts."

[9] Wisconsin Manufacturers' Association. *Classified Directory of Wisconsin Manufacturers*, 1939, Madison, Wis.

The advantages of a large local market are especially important in unstandardized materials with an element of fashion—such as apparel findings—since for these materials the manufacturer must "shop around"; variety, up-to-date styles, and quick delivery are essential.

Integration of alternative products at a single production center is limited only to the extent that it may conflict with other locational considerations which pull in different directions. If for example the two products are destined for quite differently located markets, the factor of access to markets will work against the tying-together of the processes at any location; and if this market factor is important enough it will overcome the advantages of integration. Thus, folding paper boxes and set-up paper boxes, though made of the same materials, differ greatly in bulk. As a result, the geographic distribution of these two branches of the paper-box industry is greatly different.[10] Again, any important differences in the production requirements for the two processes may likewise interfere with integration. Various kinds of leather garments—shoes, gloves, jackets, and so on—are generally made in separate plants, since any possible savings through combined buying and handling of leather would be negligible.

Within a firm, the economies of manufacture of alternative products at different plants are primarily those of cheaper supply of the raw material. If the firm is vertically integrated as well, and produces the material itself in still another plant, then the economies are those of larger-scale and more regular operation of this plant and of all handling facilities used in common by materials destined for the different products. Many steel firms illustrate this type of integration. If on the other hand the firm is not vertically integrated, and buys the material, it is likely to get better terms and at the same time conduct its own administrative work on a larger and less fluctuating scale if it goes in for more than one product. It is, of course, possible that these economies may be outweighed by the additional complexity of carrying on divergent production methods and keeping in touch with divergent market channels. Then the firm may find it advantageous to grow, up to its limits, in scale rather than in scope. This would imply narrowing its activities to one product, or relatively few. This conflict between mass production and integration in cases where management considerations impose an upper limit on growth has often been emphasized,[11] and will recur more than once in this chapter. On the other hand, in cases where the size of the market area (as delimited by transportation costs or time) is the limiting factor upon size, the economies of integration and those of large overall size are closely associated. Thus, a wood-products mill in an area of sparse demand may be unable to maintain a large enough business on the basis of the local market unless it produces a relatively diversified line. The rural "general store" is a still more familiar example of this relation between size and scope.

As tables 4 and 5 indicate, firm integration based on alternative products is comparatively common in the iron and steel, rubber, paper, and transportation-equipment industry groups, and insignificant or nonexistent in the leather and printing groups.

Byproducts

A byproduct is distinguished from an "alternative" product in that it requires, rather than supplants, the simultaneous production of the main product. One of the most familiar cases is that of the utilization of cotton. The primary product, cotton lint, is obtained by ginning, which also yields seed as a byproduct. At first the seed not needed for planting was thrown away as useless, but it is now clipped to recover the linters and pressed to extract the oil. This last process yields still a third byproduct, cottonseed hulls, which were first regarded as worthless but are now utilized as cattle feed, fertilizer, and fuel.

It is evident that much may be gained by carrying through the processing of byproducts and main products in the same plant, production center, or firm. Such savings are greatest when the "waste" from which the byproduct is made is subject to rapid deterioration, fragile, bulky in relation to value, or otherwise expensive to handle and transport. In some cases the expense of handling and transportation even for short distances is so great that the byproducts are made in the same plant, for example, the reclaiming of various products from exhaust gases. In other cases they may advantageously be transferred to other plants in the vicinity. Where the site requirements or optimum scale of operations for the further processing of the two products is markedly different, this latter procedure is likely to be followed. Thus the refuse from several fishery establishments at Gloucester, Mass., is bought by a local glue factory; and scrap-metal reclaiming is frequently done in separate establishments. Occasionally, the difference in the locational factors affecting the processing of the products is so great that the processing takes place in different production centers. Thus, many coal-tar products are shipped from coking centers to drug, chemical, and dye works elsewhere.

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[10] Folding boxes are shipped long distances, while set-up boxes are generally made in the metropolitan area where they are to be filled.

[11] See for instance Federal Trade Commission, *Relative Efficiency of Large, Medium-Sized, and Small Business*, Temporary National Economic Committee Monograph No. 13, 1941, appendix D, by Dr. Frank A. Fetter.

TABLE 4.—*Central offices involved in various types of integration, by industry groups, 1937*

Type of integration	All industries	Food and kindred products	Textiles and their products	Forest products	Paper and allied products	Printing, publishing, and allied industries	Chemicals and allied products	Products of petroleum and coal	Rubber products	Leather and its manufactures	Stone, clay, and glass products	Iron and steel and their products, excluding machinery	Nonferrous metals and their products	Machinery, excluding transportation equipment	Transportation equipment, land, air, and water	Miscellaneous industries
Total number of central offices, integrated and nonintegrated [1]	5,625	1,660	810	636	193	232	389	66	30	127	343	336	94	393	91	225
Uniform functions [2]	4,793	1,508	692	543	163	200	329	57	22	106	310	253	72	277	74	187
Single-industry central offices	3,574	1,222	512	430	83	167	220	30	16	83	260	134	51	186	38	142
Multi-industry central offices	1,219	286	180	113	80	33	109	27	6	23	50	119	21	91	36	45
Divergent functions [1]	757	209	121	23	42	43	60	16	8	8	18	100	16	53	17	23
Alternative products of same material	564	173	83	16	40	......	35	3	8	2	10	96	6	53	17	22
Byproducts of same materials	113	34	9	7	3	1	27	15	......	1	5	3	6	......	......	2
Like processes	104	10	31	......	......	43	1	......	......	5	3	5	6	......	......	......
Convergent functions [1]	938	241	72	54	22	21	88	20	9	23	58	69	28	144	33	56
Complementary materials	100	18	7	3	3	1	29	......	5	5	6	2	1	9	......	11
Complementary parts	151	......	3	5	1	......	......	......	......	2	2	23	5	71	27	12
Complementary products	78	23	12	1	1	......	16	7	1	4	2	2	1	2	......	6
Complementary industries	73	33	4	7	......	......	4	5	......	2	1	5	......	7	4	1
Auxiliary services	123	19	6	7	7	11	17	8	2	5	5	10	8	8	1	9
Auxiliary commodities	67	56	2	......	......	......	......	......	2	1	1	2	3	......	......	......
Like markets	489	143	38	35	11	9	47	3	3	8	46	32	16	65	5	28
Successive functions	565	29	131	146	78	10	18	5	......	20	5	66	12	20	8	17
Unrelated functions	95	11	7	8	3	2	32	3	......	1	8	5	2	1	1	3

SOURCE: Thorp and others, *op. cit.*, table 21, p. 164; table 22, p. 168; table 23, p. 170; table 25, p. 179; table 26, p. 180; table 27, p. 185; table 28 p. 197.

[1] The figures in individual columns add to more than the total number of central offices in the respective industry groups, since many central offices are involved in more than one type of integration and thus appear more than once in their column. Similar duplication appears within many of groups of integration types. There is no duplication between columns, however, since each central office is classified in the industry group in which it had the largest value of products, and thus appears in only one column.

[2] Central offices with two or more plants in the same census industry appear under this head. The 1,219 cases of uniform functions in multi-industry central offices represent firms which operated two or more plants in the same census industry, but also operated plants outside that industry. All such firms appear again, at least once in subsequent rows of the table.

TABLE 5.—*Percentage of central offices involved in various types of integration, by industry groups, 1937*

Type of integration	All industries	Food and kindred products	Textiles and their products	Forest products	Paper and allied products	Printing, publishing, and allied industries	Chemicals and allied products	Products of petroleum and coal	Rubber products	Leather and its manufactures	Stone, clay and glass products	Iron and steel and their products, excluding machinery	Nonferrous metals and their products	Machinery excluding transportation equipment	Transportation equipment, land, air and water	Miscellaneous industries
Total number of central offices, integrated and non-integrated [1]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Uniform functions [2]	85.2	90.8	85.4	85.3	84.5	86.2	84.6	86.4	73.3	83.4	90.4	75.3	76.6	70.5	81.2	83.1
Single-industry central offices	63.5	73.6	63.2	67.5	43.0	72.0	56.5	45.5	53.3	65.3	75.8	39.9	54.3	47.3	41.7	63.1
Multi-industry central offices	21.7	17.2	22.2	17.8	41.5	14.2	28.0	40.9	20.0	18.1	14.6	35.4	22.3	23.2	39.5	20.0
Divergent functions [1]	13.5	12.6	14.9	3.6	21.8	18.5	15.4	24.2	26.7	6.3	5.2	29.7	17.0	13.5	18.7	10.2
Alternative products of same materials	10.0	10.4	10.2	2.5	20.8	......	9.0	4.5	26.7	1.6	2.9	28.6	6.4	13.5	18.7	9.8
Byproducts of same materials	2.0	2.0	1.1	1.1	1.6	.4	6.9	22.7	......	.8	1.5	.9	6.4	......	......	.9
Like processes	1.8	.6	3.8	......	......	18.5	.3	......	......	3.9	.9	1.5	6.4	......	......	......
Convergent functions [1]	16.7	14.5	8.9	8.5	11.4	9.0	22.6	30.3	30.0	18.1	16.9	20.5	29.8	36.6	36.3	24.9
Complementary materials	1.8	1.1	.9	.5	1.6	.4	7.5	......	16.7	3.9	1.8	.6	1.1	2.3	......	4.9
Complementary parts	2.7	......	.4	.8	.5	......	......	......	......	1.6	.6	6.8	5.3	18.1	29.6	5.3
Complementary products	1.4	1.4	1.5	.2	.5	......	4.1	10.6	3.3	3.1	.6	.6	1.1	.5	......	2.7
Complementary industries	1.3	2.0	.5	1.1	......	......	1.0	7.6	......	1.6	.3	1.5	......	1.8	4.4	.4
Auxiliary services	2.2	1.1	.7	1.1	3.6	4.7	4.4	12.1	6.7	3.9	1.5	3.0	8.5	2.0	1.1	4.0
Auxiliary commodities	1.2	3.4	.2	......	......	......	......	......	6.7	.8	.3	.6	3.2	......	......	......
Like markets	8.7	8.6	4.7	5.5	5.7	3.9	12.1	4.5	10.0	6.3	13.4	9.5	17.0	16.5	5.5	12.4
Successive functions	10.0	1.7	16.2	23.0	40.4	4.3	4.6	7.6	......	15.7	1.5	19.7	12.8	5.1	8.8	7.5
Unrelated functions	1.7	.7	.9	1.3	1.6	.9	8.2	4.5	......	.8	2.3	1.5	2.1	2.3	1.1	1.3

SOURCE: See table 4, above.

[1] See note 1, table 4.

[2] See note 2, table 4.

As tables 4 and 5 indicate, firm integration based on byproducts is especially common in the petroleum and coal products, chemicals, and nonferrous metals industry groups, and nonexistent in the rubber, machinery, and transportation-equipment groups. It should be kept in mind that these tabulations refer only to cases of plants in different census industries being operated by the same central office. The extensive integration of byproducts within individual census industries is thus excluded.

Similar Production Requirements or Techniques

Economies in plant, firm, or locational integration of like processes are traceable to economies of scale in the use of particular production factors. Thus it is advantageous to combine different uses of the same equipment if such equipment can be more effectively operated on a larger scale than either use alone would provide; and the broadening of scope thus entailed may be an alternative to the increase of scale of manufacture of any one of the products. A textile spinning plant or firm or center, for instance, may obtain some advantage of scale in terms of worsted spinning alone, but if still further advantages would ensue from an increased concentration of spinning activity it may integrate so as to include cotton and other fibers as well. The shorter and simpler the operation performed, the more likely it is that it can advantageously be applied to diverse materials in a single plant or firm or location.

This element of economy is most in evidence in connection with integration in locations, since the provision and auxiliary servicing of equipment by specialized enterprises plays a large part. Thus, one of the advantages of establishing a shop for a particular sort of garments in one of the major garment centers is that there are already other shops there using similar equipment, so that it is easy to get installations, repairs, and replacements of such equipment on short notice.

Another important aspect of integration based on use of similar factors is specialized labor. It is a familiar fact that in industries in which specialized labor skill is an important locational factor, the typical geographical pattern is a heavy concentration at a few centers where for reasons perhaps now forgotten the industry happened to get a start and certain local skills and traditions cumulatively developed. Thus so far as integration within locations is concerned, the use of of like skills has been a powerful integrational factor, leading to the specialization of many centers in groups of skill-related industries.

Within a firm operating plants in different locations, the most relevant factor is probably that of technical and management personnel. A firm experienced in operating railroad car, locomotive or truck plants can add a tank plant to its responsibilities much more readily than it could take over the manufacture of explosives.

The use of similar types of land by various industries or activities is of quite different and much broader significance. Since all land is similar in its purely spatial aspect at least, and since the supply at any location is rigidly limited on account of nontransportability, the relation between uses is generally one of rivalry. Some users of land can afford to pay a rent which makes the land unavailable for less intensive uses. In this sense, every use of land competes with others, and the necessity of paying land rentals (i. e., the limited "carrying capacity" of land at any one location) is normally a decentralizing influence.

So far as manufacturing is concerned this factor of rivalry for space operates only on a local scale. A plant in Manhattan does not need to move to Wyoming to secure lower rents, but only to the suburbs. The conspicuous suburbanization trend in manufacturing industry in recent decades is due in large measure to the growth in the importance of more intensive trade and service activities which preempt the central parts of metropolitan areas.

Complementary Use of Production Factors

The advantages of complementary use of production factors in a production location does not need to be elaborated here. More stable employment and qualitatively better-balanced employment leads to lower costs for men as well as for machines. Within the individual plant or trading establishment the same points are relevant, and still more likely to produce integration in practice. The dovetailing of products with complementary requirements is recognized as an important part of plant economy.

As between different plants controlled by a firm, the only transferable factors are management, construction, merchandising, engineering, and research. There are a few cases in which firm integration has been effected in part with a view to better-rounded or stabilized employment of these "overhead" functions. Thus, under the heading of integration of "Unrelated functions." TNEC Monograph No. 27 reports:[12]

> Several central offices active in the canning industries controlled other establishments manufacturing such unrelated products as agricultural implements, turned and shaped wooden products, lumber and various types of machinery. The seasonal characteristics of the canning business were undoubtedly responsible for the diverse industry patterns in these instances. The advantages to be derived from stabilized employment may have induced the firms in these lines to take on the production of dissimiliar products. * * *

[12] Thorp and others, *op. cit.*, pp. 206–207.

In general, it may be said that investment in totally dissimilar lines is frequently identified with the desire to spread risks over more than one branch of activity. Although there is a high degree of interaction among all elements of the economy so that any up or down impulse in operations has a widespread effect, these cycles do not touch upon all phases of business at the same time, nor with like intensity. There are, therefore, certain benefits to be derived from the unified management of dissimilar lines of endeavor.

Convergent Functions [13]

Under this head are included processes giving rise to articles designed for subsequent fabrication into a single composite product or for sale to consumers through the same trade outlets. To the extent that access to market is the dominant locational factor in particular processes, any two such processes are likely to show considerable similarity of locational pattern if their markets happen to be in the same places. Thus for example both the clothing and the jewelry industries are strongly attracted to the New York City market, and have similar locational patterns. However, this similarity does not imply any genuine economies in integration between the processes involved, since each would locate near the market regardless of the other. A more significant relation exists if the serving of a market by one process either encourages or discourages the serving of the same market by another process in the same plant or firm or at the same location.

Thus a chemical firm may find it advantageous both to make acid and to mine phosphate rock, for subsequent combination in the making of superphosphate fertilizer. A well-known shoe firm makes both cloth linings and leather, as "complementary parts" for shoes. Many plants have separate departments producing packages for their products. A further example of the production of goods which have nothing in common except their final use is found in the beverage industry where several large concerns manufacture dispensing equipment especially designed for their products.

Convergent products comprise two types: complementary and "shopping." Complementary products are those which the buyer buys together to use in combination, as, for instance, lumber and nails, or coffee and sugar. "Shopping" products, on the other hand, constitute slightly varied alternative ways of satisfying the same want: for instance, overcoats of different styles, fabrics, and patterns. The distinction is primarily in that the complementary goods are likely to be of quite diverse character but are bought and actually used together in definite proportions: while "shopping goods" may be quite similar in materials and manufacture but are brought together only for comparison by the buyer, who selects one variety and leaves the rest.

So far as locational influences are concerned, complementary and shopping goods play quite similar roles. In both cases there is integration at the marketing stage and the question is merely that of how far back into the manufacturing process this integration will extend. This depends on the degree of similarity of the two products, in their materials or other production requirements, and in general there will be much more of this similarity among shopping goods than among diverse complementary products. Thus it is quite usual for a diversified line of clothing or breakfast cereals, say, to be made in the same city and even in the same plant; while on the other hand such complementary goods as bricks and lime, or golf clubs and balls, are likely to come from different locations, and converge only at the final retail stage or perhaps only at the site of consumption.

Mention has been made in the previous chapter of the powerful influence of convergent locational integration in shopping-goods manufacturing. Owing to the necessity of making market contacts, if not actually shipping goods, through one of a few major market centers, the manufacturers are strongly impelled to locate in or near such centers. The result is characteristically a high degree of locational integration. However in the cases in which manufacturing is highly concentrated at the market, full advantage of the economies of scale can be obtained by a plant or firm specializing in a single product. This contrast of highly specialized plants and firms with highly integrated production centers is characteristic of the shopping-goods group of industries as a whole.

Typical instances of local plant or firm integration of convergent functions are the following descriptions of selected Milwaukee manufacturers, taken from the trade directory previously cited: [14]

Heating and air-conditioning contractors.
Electrical control apparatus and radio parts.
Paper drinking cups, drinking cup dispensers.
Toys.
Shoe manufacturers' supplies.
House paints, industrial finishes, varnishes, enamels, mirrors, stained glass, memorial windows, store fronts, decorated glass, etc.
Butter, cottage cheese, sausage.
Hospital garments, surgical dressings, and hospital woodenware.

Firm integration based on some form of convergent functions was found in one-sixth of all central offices by

[13] As indicated in tables 4 and 5 above, the TNEC report breaks down this type of integration into several subtypes. For the purposes of the present discussion, such detail seems unnecessary.

[14] Wisconsin Manufacturers' Association, *op. cit.*

the TNEC study. Lumping together all forms of convergent firm integration, and eliminating duplications, one finds the relative incidence highest among central offices in the machinery, transportation equipment, petroleum and coal, and rubber industry groups, and lowest in the forest products, textiles, printing, and food groups.[15]

Vertical Integration ("Successive Functions")

There is frequently some economy in consolidating two or more successive steps of a complex manufacturing process in a single plant, firm, or location. Thus blast furnaces and steel works are quite generally placed in a single plant, with transfer of the iron in a molten state. The same firm may operate fabricating mills in the same or other locations.

It is difficult in many instances to separate the successive functional relationship from the complementary or auxiliary relationships; especially since they are frequently found in combination.[16] In general, if the identity of the product is maintained through a number of distinct steps, the relationship may be termed successive; whereas, the relationship may be termed either auxiliary or complementary if the product loses its identity in the process, regardless of the fact that it may be indispensable to the productive operation, or if it is possible to manufacture simultaneously, and not in a sequence of operations, the separate products necessary to complete the ultimate product.[17]

The simplest measure of the extent of integration of production in individual establishments is the percentage ratio of value added by manufacture to value of products. This method is appropriate for finished-goods industries at least, and appears to be the only possible way in which different instances of integration can be quantitatively measured and compared.[18] However, for industries producing semifinished goods it may give a misleading impression, in that it shows the individual plant's relative share in the creation of the value of the goods in the form in which they leave that plant, rather than in their ultimate form. For this reason the measure has here been applied (in tables 6 and 7) only to industries which turn out at least a sizeable proportion of their products in finished form.

[15] Table 5, above.

[16] See for example, the analysis of integration in iron and steel manufacture, in Thorp and others, *op. cit.*, pp. 201–203.

[17] These distinctions are given as the basis of the TNEC classification.

[18] Some have objected to this measure on the score that it shows a higher degree of integration in a plant employing expensive highly skilled labor. But is not labor cost the market evaluation, at least, of the economic contribution of that labor to the finished product? Only in money terms does it seem possible to evaluate even approximately the relative economic significance of different productive operations.

TABLE 6.—*Finished-goods manufacturing industries with greatest vertical plant integration, 1939*

[As measured by ratio of value added by manufacture to value of product]

Industry	Value added by manufacture as percentage of total value of products
All manufacturing industries	43.5
Firearms	82.9
Hotel china	81.9
Office and store machines, n. e. c.	80.8
Ice, manufactured	80.2
Roofing tile	79.5
Files	78.3
Pottery products, n. e. c.	77.2
Embroideries, other than Schiffli-machine products—contract factories, regular factories, and jobbers engaging contractors	76.8
Clay products (excluding pottery), n. e. c.	76.5
Terra cotta	76.2
Sewer pipe and kindred products	74.9
Communication equipment	74.8
Newspapers (publishing and printing)	74.6
Printing-trades machinery and equipment	73.0
Tableware, pressed or blown glass and glassware, n. e. c.	72.3
Brick and hollow structural tile	72.3
Statuary and art goods (excluding stone and concrete)—factory production	71.7
Periodicals (publishing and printing)	71.5
Bookbinding and related industries	71.3
Surgical and medical instruments	71.2
Sewing machines, domestic and industrial	71.1
Professional and scientific instruments (excluding surgical and dental)	71.0
Floor and wall tile (excluding quarry tile)	71.0
Chewing gum	71.0
Whiteware	70.8
Machine tools	70.8
Mechanical power-transmission equipment	70.5
Books (publishing and printing)	70.5
Hand stamps, stencils, and brands	70.3

SOURCE: Calculated from data in *Census of Manufactures, 1939*, "Preliminary Report on Value of Products and Value Added by Manufacture, United States Summary," Dec. 29, 1940.

TABLE 7.—*Finished-goods manufacturing industries with smallest vertical plant integration, 1939*

[As measured by ratio of value added by manufacture to value of product]

Industry	Value added by manufacture as percentage of total value of products
All manufacturing industries	43.5
Creamery butter	14.9
Cheese	15.5
Meat packing, wholesale	15.9
Cooking and other edible fats and oils, n. e. c.	17.1
Poultry dressing and packing, wholesale	17.1
Petroleum refining	21.4
Cigarettes	21.8
Condensed and evaporated milk	22.0
Blended and prepared flour made from purchased flour	22.0
Flour and other grain-mill products	22.1
Salad dressings	22.6
Cane sugar, including products of refineries	24.1
Prepared feeds (including mineral) for animals and fowls	24.7
Cured fish	29.7
Preserves, jams, jellies, and fruit butters	29.9
Fertilizers	32.5
Motor vehicles, motor-vehicle bodies, parts and accessories	32.7

SOURCE: Calculated from data in *Census of Manufactures*, 1939, "Preliminary Report on Value of Products and Value Added by Manufacture, United States Summary," Dec. 29, 1940.

The average "vertical-integration percentages" for individual industries show a wide degree of variations as indicated by the tabulation of the more extreme cases in tables 6 and 7. It will be observed that guns come first and butter last. Machinery and apparatus as well as building materials also rank high in integra-

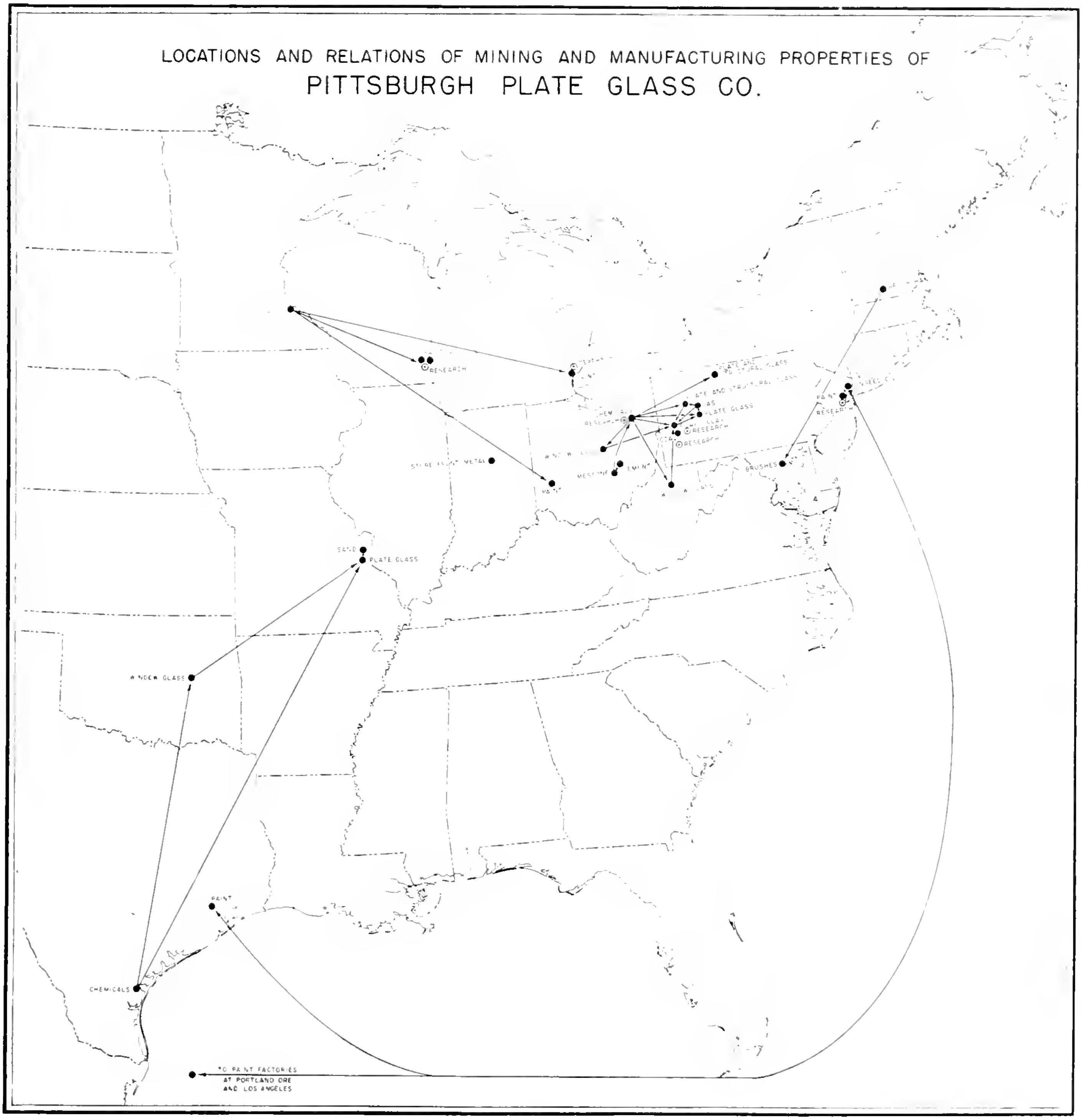

FIGURE 91

tion, while the low-integration group consists primarily of food products, in which a relatively large part of the value is created by agriculture.

The same measure of integration is shown for 1937 by industry groups in table 8, and bears out the impression given by tables 6 and 7. In table 9, the same ratio is shown for manufacturing industry as a whole by census years since 1849. The striking fact here is that the measure has shown neither an upward nor a downward trend over the past 90 years. Apparently there is great stability in the over-all extent of vertical integration of manufacturing plants.

Essentially, the advantages of vertical integration are based on reduction of transport or handling costs

in the case of locational and plant integration, and on the strategy of control of material sources and market outlets.[19]

On the basis of transport costs, the successive processes can advantageously be carried on at a single location if the earlier process is "market-oriented" or if the later process is "material-oriented," or both. The direction of orientation of a process depends upon the relative amounts of material and product and upon their relative unit rates of transport. Usually the initial processing of a raw material is a "weight-losing" process, involving reduction in tonnage and bulk; for instance, the primary smelting or beneficiation of ores, or the ginning of cotton. Most of these earlier stages as a result are located at assembly points near raw-material sources, in order to obviate unnecessary transport of waste material. On the other hand, the later stages of production involve generally an increase in the bulk, fragility, and unit transport cost of the commodity, and the preparation of goods for final consumption is more likely to take place at distribution centers near final markets.

Thus the sequence of manufacturing operations is "pulled apart," in the typical case, with the initial stages gravitating toward raw-material sources and the final stages gravitating toward consumer markets. On the basis of transport considerations alone (including speed and service as well as freight rates) a "split" in location is the logical result. Very few processes show complete vertical locational integration. The chief force working for vertical locational integration is the opportunity of transferring intermediate products more conveniently over very short distances than over longer distances: as, for instance, molten iron, which can be trundled rapidly to a steel furnace at low cost if the distance is very short, but otherwise has to be cast into pigs, loaded, transported, unloaded, and remelted. Similarly when intermediate products are bulky (like gases or wood pulp), fragile (like instrument parts), dangerous (like acids or explosives), or subject to rapid style obsolescence (like fancy leather and apparel findings) the advantages of vertical locational integration are great. So there is close linkage between blast furnaces and steel works; between pulp mills and paper mills; between coke ovens and blast furnaces; and between apparel-findings factories and apparel factories. On the other hand, if the intermediate product has none of these special difficulties of transport, vertical locational integration generally does not result. Thus the smelting and refining of nonferrous metals are generally separated geographically, since the intermediate product shows no special difficulties of transport. Textile mills, likewise, are not generally integrated locationally with garment plants, and no great evidence of geographical linkage appears

TABLE 8.—*Extent of vertical integration in establishments, by industry groups, 1939, as measured by ratio of value added by manufacture to value of products*

Industry group	Value of products (millions of dollars)	Value added by manufacture	
		Millions of dollars	Percentage of value of products
All manufacturing	56, 843	24, 683	43. 4
Printing, publishing, and allied industries	2, 578	1, 766	68. 5
Stone, clay, and glass products	1, 440	911	63. 3
Machinery (except electrical)	3, 254	1, 969	60. 5
Miscellaneous industries	1, 163	694	59. 7
Electrical machinery	1, 727	1, 000	57. 9
Lumber and timber basic products	1, 122	618	55. 1
Transportation equipment, except automobiles	883	472	53. 4
Chemicals and allied products	3, 734	1, 880	50. 3
Furniture and finished lumber products	1, 268	627	49. 4
Textile-mill products and other fiber manufactures	3, 931	1, 822	46. 4
Rubber products	902	406	45. 0
Iron and steel and their products, except machinery	6, 592	2, 956	44. 8
Paper and allied products	2, 020	870	43. 1
Leather and leather products	1, 390	584	42. 0
Apparel and other finished products made from fabrics and similar materials	3, 325	1, 381	41. 5
Food and kindred products	10, 618	3, 556	33. 5
Automobile and automobile equipment	4, 048	1, 322	32. 7
Nonferrous metals and their products	2, 573	824	32. 0
Tobacco manufactures	1, 322	350	26. 5
Products of petroleum and coal	2, 954	675	22. 9

SOURCE: *Census of Manufactures*, 1939, pt. 1. Ratios calculated.

TABLE 9.—*Degree of vertical integration within establishments, as measured by ratio of value added by manufacture to value of products, for all manufacturing industries, 1849–1939*

Census year	Value of products (millions of dollars)	Value added by manufacture	
		Millions of dollars	Percentage of value of products
1849	1, 019	464	45. 5
1859	1, 886	854	45. 3
1869	3, 386	1, 395	41. 2
1879	5, 370	1, 973	36. 7
1889	9, 372	4, 210	44. 9
1899 [1]	13, 000	5, 657	43. 5
1899 [2]	11, 104	4, 662	42. 0
1904	14, 346	6, 039	42. 1
1909	20, 068	8, 192	40. 8
1914 [3]	23, 444	9, 423	40. 2
1914 [4]	23, 065	9, 241	40. 1
1919	60, 054	23, 770	39. 6
1921	41, 749	17, 303	41. 4
1923	58, 288	24, 630	42. 3
1925	60, 926	25, 732	42. 2
1927	60, 472	26, 426	43. 7
1929	68, 178	30, 737	45. 1
1931	39, 830	18, 601	46. 7
1933	30, 557	14, 008	45. 8
1935	44, 994	18, 553	41. 2
1937	60, 713	25, 174	41. 5
1939	56, 829	24, 711	43. 5

[1] Including hand and neighborhood industries, as in previous census years.
[2] Excluding hand and neighborhood industries, as in subsequent census years.
[3] For all establisbments having products valued at $500 or more, as in previous census years.
[4] For all establishments having products valued at $5,000 or more, as in subsequent census years.

SOURCE: *Census of Manufactures*, 1937, part I, table 2, pp. 18–19, and *Census of Manufactures*, 1939, "Preliminary Report of Value of Products and Value Added by Manufacture," United States Summary, Dec. 29, 1940.

[19] For an illuminating discussion of the private and social advantages of vertical firm integration, see S. R. Dennison, "Vertical Integration and the Iron and Steel Industry," in *Economic Journal*, June 1939, pp. 244–258. See also TNEC Monograph No. 13, *Relative Efficiency of Large, Medium-Sized, and Small Business*, Appendix D (statement by Dr. Frank A. Fetter), pp. 403–410ff.

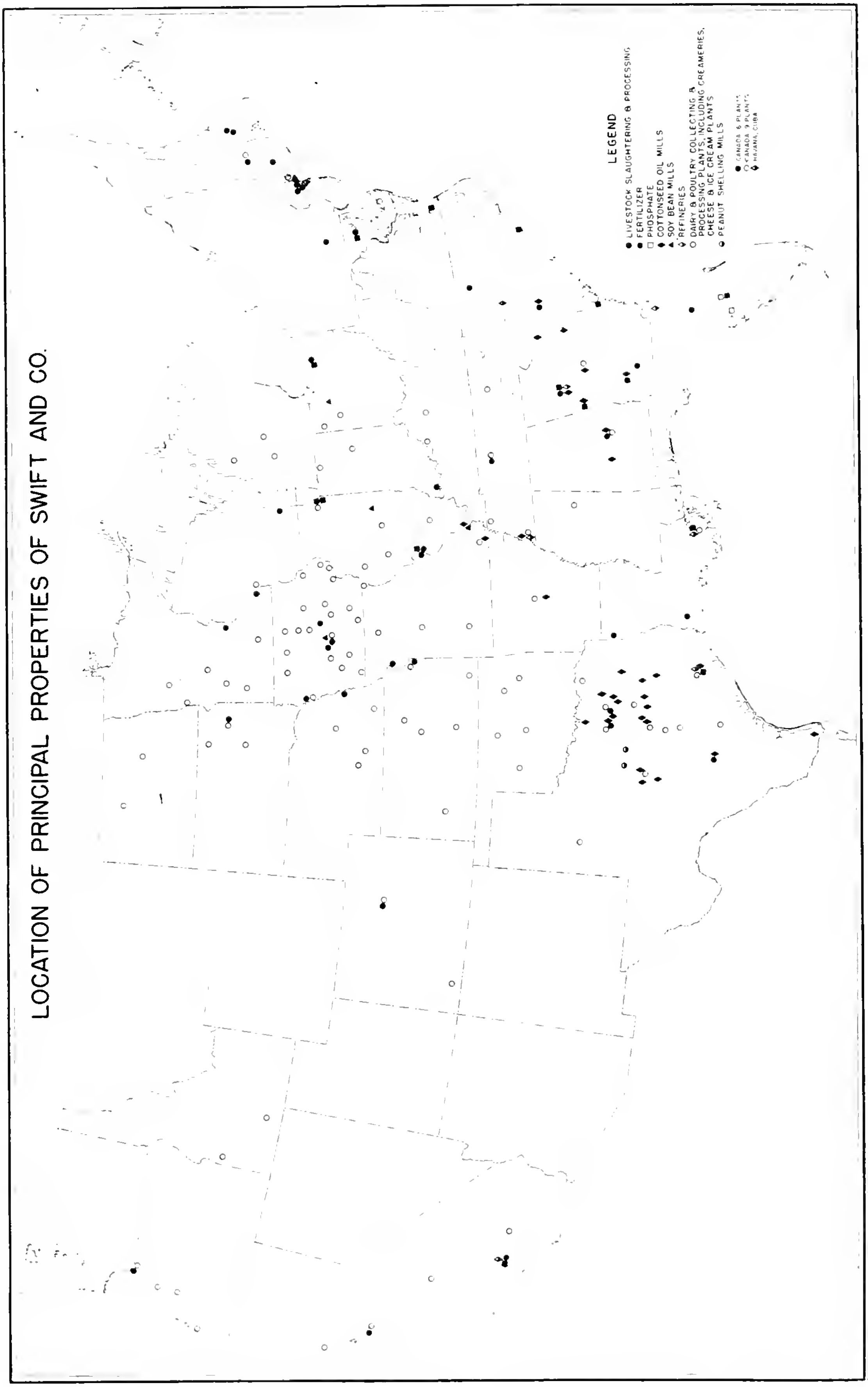
LOCATION OF PRINCIPAL PROPERTIES OF SWIFT AND CO.
LEGEND
LIVESTOCK SLAUGHTERING & PROCESSING
FERTILIZER
PHOSPHATE
COTTONSEED OIL MILLS
SOY BEAN MILLS
REFINERIES
DAIRY & POULTRY COLLECTING & PROCESSING PLANTS, INCLUDING CREAMERIES, CHEESE & ICE CREAM PLANTS
PEANUT SHELLING MILLS
CANADA 6 PLANTS
CANADA 9 PLANTS
HAVANA, CUBA

FIGURE 92

between sole-leather tanneries and shoe factories or between lumber mills and furniture factories.

In most industries, vertical integration within firms offers little in the way of technical economies over and above what can be obtained within plants or by locational integration involving separate firms. The desire for control over the stability of markets and prices is the principal motivating consideration, and the locational effect is indirect, resting merely on the convenience of having the various units of a firm close together. This last is not a very powerful force, since successive stages of manufacture involve entirely distinct production problems, and coordination between plant units is a relatively simple matter of quantitative scheduling of transfer. In the iron and steel industry the economies of vertical firm integration are perhaps as great as anywhere, and the actual extent of the integration is impressive. There is a tendency, however, to confuse the strategic with the social advantages, and also to confuse the advantages of firm integration with those of plant or locational integration.[20]

Vertical firm integration occurs in about 10 percent of all central-office firms according to the TNEC tabulation.[21] It shows the highest relative importance in the paper, forest products, and iron and steel industry groups, and the lowest in the rubber, stone-clay-and-glass, and food groups.

Summary of Locational Aspects of Integration

The essential effect of integration economies is that each of the processes involved is drawn toward the other. The mutual attraction may take the form of a better market for the products of both processes, or a better supply of materials for both, or better markets for one and better material supply for the other, or a reduced cost of production in one or both of the processes. Integration of more than two processes may, of course, provide a combination of advantages.

Realization of the economies in question sometimes requires merely geographic proximity, that is, location in the same producing center. In other cases, however, the processes must be combined in the same firm or even in the same plant in order to reap the full benefit.

The possibility of realizing integration economies means, of course, that the two processes are interdependent in choice of location. The best place for one cannot be determined unless the location of the other is known.

Sometimes the advantages of integration outweigh all conflicting locational considerations and are decisive. Then the various processes are always found integrated, and may be considered as a collective whole rather than severally. The many dozens of successive and complementary operations in assembling shoes,[22] for example, are nowadays almost universally performed under one roof. One may speak then in terms of the location of the making of shoes as a combined process, rather than of the locations of the several processes. This customary grouping of intimately related processes is roughly recognized by the concept of an "industry," though most industry classifications embrace a wider scope of operations than is found in the typical plant in the industry. There is probably no industry in which all plants perform exactly the same series of operations.

In many cases, related processes show consistent integration in production centers even though perhaps not in plants or firms. Byproduct utilization is the most familiar type of instance here. Thus sawdust and other wood waste is used mainly in the immediate neighborhood of the sawmills, and the chief byproducts of meat packing are likewise worked up in the slaughtering centers. There are exceptions in both industries. The advantage of processing the byproduct at its source depends to a large extent on whether this processing reduces or increases transportability. For example, when wood flour is used as a filler in plastics it enters fully into the weight of its product and consequently transport charges may be lessened by shipping the wood flour to a plastic molding plant located at a market for molded products. Similarly, some of the byproducts of the packing industry are converted into final products at least as bulky or expensive to transport, and thus tend to be shipped to converting plants nearer the markets for these final products. Nevertheless, the general rule is that byproducts processing is locationally linked to the operation which gives rise to the byproduct. This locational interdependence works more in one direction than in the other. For example, the location of tanneries is strongly influenced by considerations of nearness to packing houses, but in the location of packing houses nearness to tanneries is a very minor factor. In 1935, all of the 73 jewelry-findings establishments in the United States were located in 6 counties, all of which had jewelry factories; but these counties had only 649 of the 995 jewelry establishments in the country. The

[20] Cf. Dennison, *op. cit.*

[21] Cf. tables 4 and 5 above. The TNEC definition of "successive functions" is rather narrow, excluding as it does the manufacture of auxiliary products and commodities.

[22] Heel making and the cutting out of soles are the only processes often carried on in separate establishments.

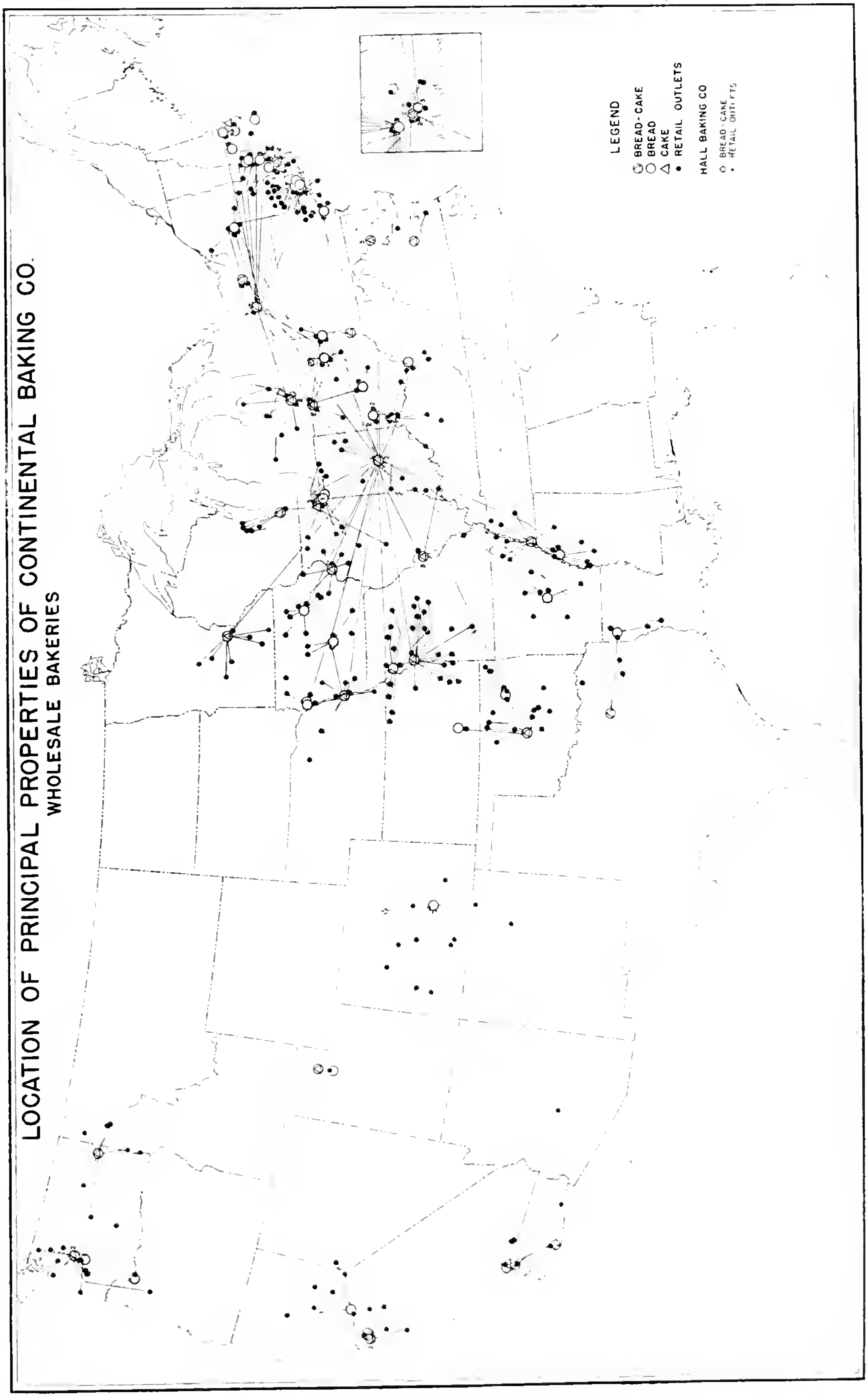
LOCATION OF PRINCIPAL PROPERTIES OF CONTINENTAL BAKING CO.
WHOLESALE BAKERIES
LEGEND
BREAD-CAKE
BREAD
CAKE
RETAIL OUTLETS
HALL BAKING CO
BREAD-CAKE
RETAIL OUTLETS

FIGURE 93

remaining 346 were in 67 counties devoid of jewelry-findings establishments.[23]

The concept of an "ancillary" industry, dependent in location on some other industry, is familiar. It is evident that the distribution of these ancillary industries cannot be considered apart from the distribution of the industries upon which they are dependent. Not always so evident, however, is the reverse effect. Often the number and variety of ancillary establishments clustered around some primary industry is such that the locational dependence of the primary industry on the ancillaries, though small in respect to each one, is great in respect to the total. Unquestionably one of the great advantages of New York City as a garment factory location is the variety of specialized trade supplies and services available there. It is clear that there is a certain cumulative aspect in the concentration of industries tied up with highly specialized ancillary establishments. The closeness of the geographic association can be measured—though of course not explained—by coefficients of linkage such as those described in an earlier chapter. Analysis of locational advantages on the basis of comparative costs is a complex matter when many types of auxiliary supply and service have to be taken into account.

Ancillary industries fall into two broad classes, according to whether they sell to or buy from the primary industry. In the selling category are included containers, ice, compressed gases, apparel findings, foundries, and service enterprises of many kinds, while the buying ancillaries include most byproduct idustries.

It has been stated that in practically all industries there is some latitude in the scope of integration actually found, as between different plants, different firms, or different production centers. In most industries the degree of latitude is quite large. Some automobile plants, for example, are highly integrated and others are highly restricted in scope. Some shoemaking towns perform virtually all the operations and produce virtually all the various types of product in the industry, while others specialize in one or two types and may purchase all their cut stock and findings outside.

It is interesting to observe that one degree of integration often serves as a substitute for another degree. In production centers which contain many plants or firms and are highly integrated, there is less need for any individual plant or firm to be highly integrated, so narrow specialization is the rule. As was pointed out in previous chapters, production operations are parcelled out to a greater extent in such places. On the other hand, in smaller and less integrated production centers the individual firm or plant may be forced to branch out.

Where such latitude of degree and scope of integration exists, the rational planning of locations is evidently complex, for the thing to be located is not a specific process with definite locational requirements, but a bundle of associated processes, including more or fewer according to the type of location in view. To take a comparatively simple case involving successive integration, the placing of any considerable amount of additional aluminum-producing capacity calls for the placing of bauxite-reduction works as well, and must be considered not only in relation to those but to the location of existing or planned fabricating plants also. Between the bauxite mines at one end and the market for aluminum products at the other, there must be built a chain of 3 links: Bauxite reduction, electrolysis, and fabrication. The best location for any of the 3 links depends, at least to some extent, upon the location of at least 1 of the other links. If the number of feasible locations for each were very large, the resulting problem of simultaneous adjustment would be tremendously complex and perhaps insoluble. Fortunately for the peace of mind of all concerned, the location of most types of plants can often be simmered down to a small number of possible sites. For the example in hand, it is evident that if we consider only 2 alternative bauxite-reduction locations, 3 electrolysis locations, and 3 locations for fabricating plants, the maximum number of combinations is only 18. Out of these, some can be eliminated at once and the final choice may involve detailed cost analysis of only 3 or 4 possible set-ups.

This matter of actual procedures for determining locations for new plants, expansions, or plant transfers is taken up in greater detail in the final chapter of this volume.

Trends of Integration and Their Locational Implications

Any statement as to trends in one industry would entail investigation of the technical and other developments in prospect in that industry and would go beyond the purpose of this report. It is desirable, however, to indicate the over-all effect of a few major developments on industrial integration and location in general. It is recognized that not all of these trends may continue, and that others not here mentioned may prove to be more significant.

Cheaper and more flexible short-haul transportation, contributed by the motortruck, can be expected to further locational integration at the expense of plant integration. The possibility of trucking materials,

[23] Based on compilations from Bureau of Foreign and Domestic Commerce, *Industrial Market Data Handbook*, 1939.

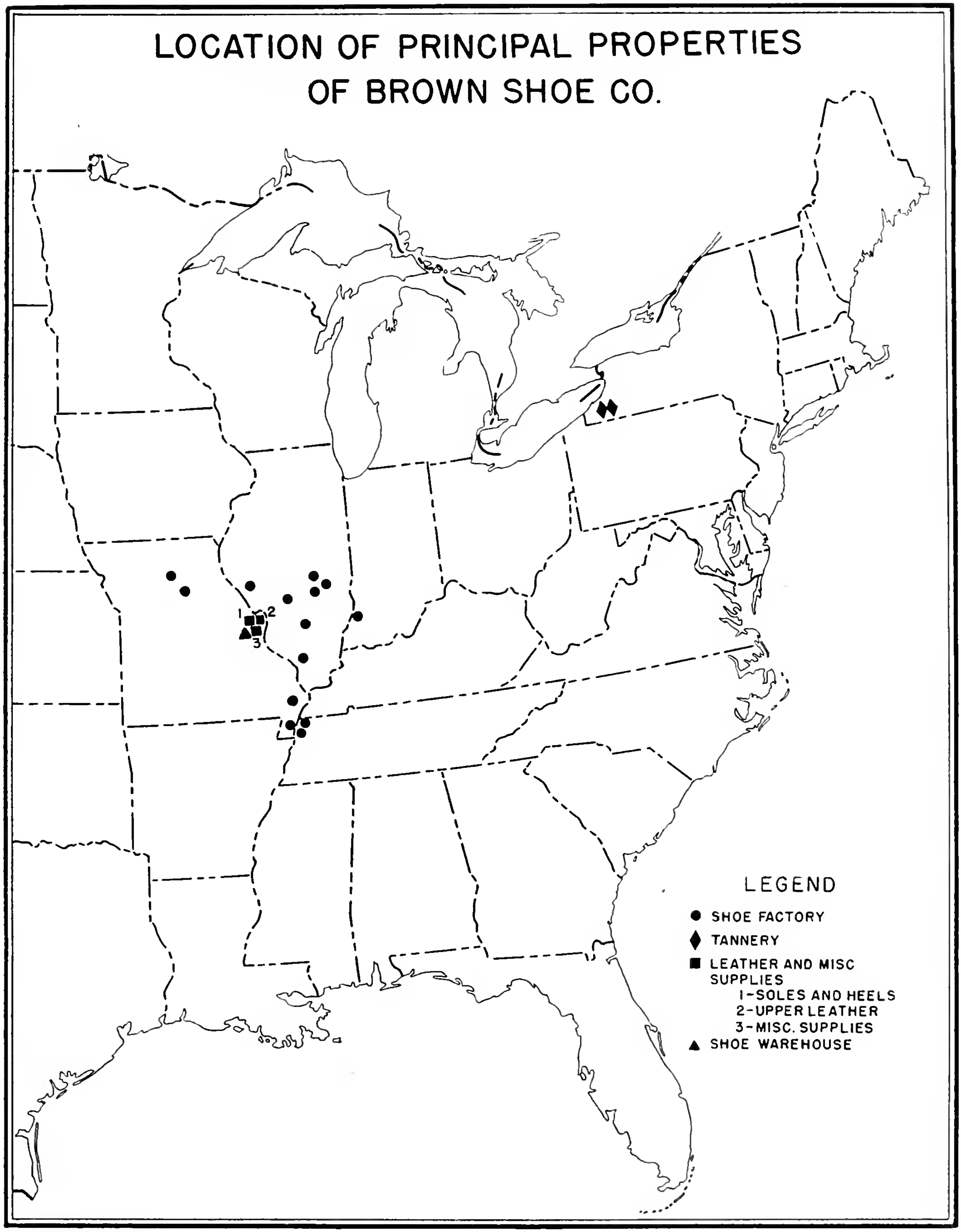
LOCATION OF PRINCIPAL PROPERTIES
OF BROWN SHOE CO.
1
2
3
LEGEND
SHOE FACTORY
TANNERY
LEATHER AND MISC SUPPLIES
1-SOLES AND HEELS
2-UPPER LEATHER
3-MISC. SUPPLIES
SHOE WAREHOUSE

FIGURE 94

supplies, and products from one plant to another as needed makes it possible to treat a whole industrial area as one vast industrial plant. Individual establishments in many cases find it profitable to narrow the scope of their operations and to be linked by truck transport to a variety of complementary and service establishments. It seems likely that this trend will continue, as it is reinforced by improvement of intra-metropolitan communications and by the forced emphasis on subcontracting and pooling incident to the defense effort. Some of the contacts and arrangements arrived at under the stress of the current expansion will probably be found advantageous enough to continue after the pace slackens.

The rapid development of passenger air transport has enabled business executives to keep in touch with affairs in widely separated locations, and thus has the general effect of encouraging firm integration at different locations as against integration at a single plant or location. This trend to geographic mobility of management has unquestionably been accelerated by the pressure of the defense program under which many large concerns have taken on new plants far removed from their main seat of operations. Although some of this dispersion of activities is justified only on emergency grounds,[24] there is no doubt that commercial airline service will be greatly increased as soon as planes become available, and that the executive of the future will travel extensively. Convenience of administration will then lose some of its force as a factor of geographic integration, and many now clustered organizations will have the opportunity of decentralizing if they see fit to do so.

Another well-established trend is the increase in importance of luxuries and style goods.[25] Reference has been made in various chapters of this report to the locational characteristics of this type of industry, in particular locational integration on the basis of like processes, like markets, complementary and auxiliary functions. Apart from any change in the degree or type of integration practiced in industries of this character, their increase in relative importance promises an element of trend toward large highly integrated clusters of small nonintegrated plants and firms.

In the sphere of industrial technique, one fairly probable trend is an increase in the importance of chemical as against mechanical processing. The replacement of natural materials by synthetics is merely one aspect of this trend. The basic raw materials are still relatively few, but more diversified products and byproducts are being obtained from each.

Chemical processing entails generally much more complex relationships of complementary materials and byproducts than is the case with mechanical processing. The potential technical linkages and incentives to integration are correspondingly greater. It is interesting to note in this regard that the relative prevalence of branch plants related through byproducts is greatest among firms in the fields of petroleum and coal products, chemicals and allied products, and nonferrous metals and their products.[26]

A continued growth in importance of the chemical process industries means a greatly increased technical interrelation of processes, and probably more plant and locational integration. Relatively localized centers of chemical industry, based on raw materials and cheap electric power, will bulk larger on the industry map.

Finally, there has in the past been a trend toward "big business," in the sense of extension of industrial control by large firms and interest groups. The question of whether this trend should be permitted to continue is outside the province of this particular chapter, but if it does continue the effect of increasing firm integration is likely to show up in increasing integration of functions in locations as well. Distance is still some handicap to effective coordination and control. The effect on integration within individual plants is more doubtful. Probably in the majority of cases diminished plant integration will result, as illustrated by the merger of two large rubber companies some years ago. Under separate control, each had been producing both tires and footwear for the national market, but after the merger, tire production was concentrated in the one plant and footwear production in the other. This was a case in which firm integration (of divergent functions) replaced plant integration, though the two factories are several hundred miles apart. Had they been closer, the advantages of firm integration would presumably have been all the greater.

Such are some of the influences which will operate upon the location of industry through the economics and politics of integration. It is evident that these trends may work in different directions and degrees in different types of industry, and in some cases may offset one another.

[24] It should be noted that this separation would have taken place to a much greater extent (particularly in the aircraft industry) had it not been for the reluctance of management to undertake remote control.

[25] Cf. Arthur F. Burns, *Production Trends in the United States Since 1870* (National Bureau of Economic Research, New York, 1934), pp. 60, 173, and *passim*.

[26] See table 5, above. The figures scarcely do justice to the degree of integration in the chemicals field, since a large part of the industry group is lumped together by the census as "Chemicals, not otherwise classified." The TNEC tabulations on integration are based on relations between branch plants in different census industries, and consequently disregard the manifold relationships between branch plants.

Branch-Plant Organization in Selected Concerns

Any comprehensive review of the actual relations of products, plants, firms, and production centers is of course out of the question. The most that can be done in any general report on the location of industry is to exhibit a few characteristic patterns by way of illustration. One of the Board's earlier studies, *The Structure of the American Economy*, has a series of maps showing the distribution of plants in individual industries of characteristic types of locational pattern. That series is here supplemented by four maps of branch-plant organization in individual manufacturing companies. In each case, there is firm integration; that is, two or more different products are turned out by plants of the same firm. All four concerns have nation-wide markets.

The mining and manufacturing properties of the Pittsburgh Plate Glass Co. (Fig. 91) afford more than one example of vertical integration. The plants of this company fall into five groups of interrelated productive units. Two separate groups are engaged in the production of glass products; two groups produce paint, varnish, and lacquer; and one group turns out brushes. One isolated plant manufactures store-front metal.

The cluster of plants in eastern Ohio and western Pennsylvania which form one of the company's glass-producing units contains the most complex supply relationships of the four groups. The productive process starts with the quarrying of limestone at Fultonham, Ohio. This limestone enters into the production of soda ash at the Barberton plant, which is the supplier for the five glass plants in the area. Further connections exist between the glass plants. For example, the manufacture of duplate safety glass at Creighton, Pa., is based upon supplies of window glass from plants in Mount Vernon, Ohio, and Clarksburg, W. Va. It is interesting to note that in the case of the Creighton plant, integration has been extended to fuel; gas being brought in from the company's properties at Ford City.

The second of the glass-producing groups represents on a smaller scale a similar pattern of vertical relationships. The interplant relationships involved in the company's paint and brush manufacturing activities will be evident from the map.

Examples of differing degrees of material orientation are offered by the properties of Swift & Co. (Fig. 92). The company's phosphate plants are of necessity located at sources of phosphate rock. Plants which process livestock, poultry and dairy products, cottonseed, soybeans, and peanuts are found at convenient collecting points for these bulky or perishable materials. The location of livestock slaughtering and processing plants at important railroad centers reflects both the presence of economies of scale and the desirability of closeness to markets. Influence of a former supply relationship that has lost its importance may be seen in the proximity of several fertilizer plants to meat processing plants. The continued existence of these fertilizer plants is explained by their location in fertilizer-using areas. The presence of a number of refineries on the seaboard is due to the fact that these refineries import part of their materials and export part of their final product. Refineries in the interior of the country are in areas from which they draw their supplies.

The principal properties of the Continental Baking Co. and its subsidiary the Hall Baking Co. (Fig. 93), indicate a high degree of market orientation. The pattern of retail outlets conforms closely to consumer concentration in the areas served by the concern. The locations of wholesale bakeries represent a compromise between the attraction of markets and economies of scale. In size of market area, the Indianapolis and Buffalo baking plants are evidently in a class by themselves.

Finally, the Brown Shoe Co. (Fig. 94) shows a pattern quite distinct in character from all the others. Neither materials nor markets play a leading role in this case, but the lower labor costs and certain other inducements of small towns have shaped the pattern. Sole and upper leather come from two separate tanneries in western New York to separate plants in the headquarters city, St. Louis, whence soles, heels, and other leather pieces are sent out to the 14 small-town shoe factories scattered within a 200-mile radius. Finished shoes are sent back to St. Louis for distribution to merchants all over the country.

Implications of the Analysis of Scale and Scope

In this chapter and the previous one an attempt has been made to explain the complex interdependence that exists between the locational requirements of a production process and the scale and scope of the units in which the process is organized.

The practical importance of this analysis lies in the fact that the scale and scope of a plant must be planned when the plant is set up and unless it is planned with some regard to the optimum scale and scope for that industry in that locality, both private and public loss will result from a misuse of resources. Where the

locality being considered already has plants of that industry, their characteristic scale and scope may perhaps be taken as a rough index of what is feasible; but where a plant is to be set up in a location new to that industry this guidance of experience is absent, and some analysis of the conditions of the local relation of costs to scale and scope is called for. Any active policy aimed at modification of existing locational patterns or trends, especially modification in the direction of decentralization or diversification, is particularly likely to encounter the question of the proper scale and scope for a kind of enterprise new to the community where it is proposed to locate.

In order to apply the appropriate analysis it is necessary, then, to have some technique for determining which are the controlling elements in scale and scope of plant, and how they vary geographically. It is hardly to be expected that any such techniques can yield exact results, in view of the fragmentary character of our data and the variability of the conditions themselves; but even rough determinations are better than none at all.

CHAPTER 16. FINANCIAL CONTROLS AND MONOPOLISTIC INFLUENCES

By Gardner Ackley*

The establishment or existence of some degree of common control over what have been, or are potentially, independent production units may in many cases cause important deviations in the locational structure of some or all of the units involved. This common control may be established by any of numerous means, and may vary from a loose and vaguely defined "community of interests" to the actual common ownership or merger of the units involved. Pools, "trust" arrangements, price or production agreements, patent controls, holding companies, investment companies, intercorporate stock ownership, are all methods by which, to greater or lesser degree, single control is exerted over what had been, or could potentially be, independent units. The common control may combine units producing a single commodity—in which case we can properly use the term "monopolistic influences"; [1] it may combine related processes, or it may involve the production of entirely unrelated items. A further breakdown separates those cases where the common control is exerted for the benefit of the group as a whole from those cases where the control is exerted over some units in the group in the interests of others.

The field thus embraces a vast area of business relationships, but we are concerned only with those relationships which have some effect upon the location of industry. The grouping of units under common control need not have any effect whatsoever upon the location of the constituent units. Relative advantages of nearness to markets or materials for each unit, the purely technical advantages of scale of plant and many of the other locational factors remain unchanged by such combination; hence there may be no cause for altering locational patterns. Yet such a grouping may so modify certain of these factors as to induce substantial changes in the locational structure of the industry.

It will be impossible, in a brief discussion, sharply to distinguish the separate locational effects which may flow from each of the various methods and degrees of common control. Different results may in some cases arise from the establishment of common control over previously independent units than would arise from the existence of the common control at the time that the units were established. These differences, likewise, cannot in each case be indicated. The following brief discussion, therefore, is intended to be illustrative rather than exhaustive of the possibilities.

Monopolistic Influences

Some of the locational effects of common control over units producing what is substantially a single commodity are suggested in the following paragraphs.

A. The substitution of monopoly for competition in an industry frequently leads to a reduction in output, in order to enhance prices and profits. This reduction may be accomplished by the abandonment of some plants, and hence, perhaps, some producing locations, previously operating. The reduction will be accomplished in this way if there are definite economies of scale, which make it more economical to concentrate the smaller production in a few of the plants than for each plant to operate at a lower rate.

Many examples of monopolistic output restriction through the closing down of some units which had operated before the establishment of monopoly control can be found in the records of the American "trust" era. A more recent example is provided by the merger of window-glass producers.

Before 1935, there were 3 large concerns in this industry, and 12 small ones. The leading executive of 1 of the latter companies was then able, with certain financial assistance arranged for him by the 3 leaders in the industry, to buy up the rest, mainly in 1935 and 1936. Two of the plants, the only ones of their kind in 2 States of the Southwest, were permanently closed after their purchase, and 2 others in the Northeast. Three other plants in Pennsylvania were operated only a few months, when 2 of them were conveniently visited by strikes; and the eighth plant in West Virginia, larger than any of the 7 so far mentioned, was acquired in 1938 and closed the same month. Almost half of the assets of the 12 merged companies lay in these discontinued enterprises. In 1939 the new consolidation surpassed in production 1 of the 3 former "leaders" assisting it. Today there are only 4 manufacturers of window glass in the United States.[2]

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[1] The combination of similar units which does not result in any substantial lessening of the degree of competition—because even after combination the firm controls only a small percentage of the output—is simply a case in which the optimum size of the firm is larger than the optimum size of the plant. It is discussed, above, in chapter 14 "Size of Plant, Concern, and Production Center."

[2] Clifford L. James, Edward C. Welsh, and Gordon Arneson, *Industrial Concentration and Tariffs*, Temporary National Economic Committee, Monograph No. 10, 1941, pp. 47–54.

Likewise, the acquisition, in the 1920's, of the existing Pacific coast steel plants by the dominant steel interests seems to have forestalled an expansion of steel capacity on the west coast, which might have taken the form of one or more integrated or semi-integrated units. At a time when there was surplus capacity in the East, the desire to "dump" some of their surplus in the Pacific market made the larger producers fear the establishment of new capacity which could locally undersell steel imported from the East.

In the case of products produced for a regional rather than a national market, monopolistic controls may operate to maintain prices merely in certain areas where the control is strongest. In the glass container industry, for instance, patent controls exist on the essential machinery which allow container producers connected with the group owning the patents to avoid or reduce local competition. Licenses to use the patented machinery are granted to new producers in areas where members of the controlling group do not have plants, but may not be granted for localities where the members of the controlling group have production facilities.[3] This arrangement means that new plants are established in some areas but not in others.

In all of the above examples, certain producing locations were abandoned or failed to be used when monopoly control existed, in order to reduce the total industry output with raised prices and profits for the remaining units. This output reduction would produce greater total profits, and thus be in the interests of the group as a whole, if the smaller output could be sold for a greater total revenue (i. e., if the resulting price rise were greater, proportionately, than the reduction in output). Thus, if the members of the group formed a voluntary pool, agreeing to share the total profits on some mutually satisfactory basis, the elimination of some of the producing units would be in the interests of all of the members of the pool.

If, on the other hand, any reduction in output by the members of a group would allow a price rise which was proportionately less than the output reduction—so that total income of the industry were reduced—then to abandon some producing units in the group would not be in the interests of the whole industry. If, however, by predatory tactics, one firm or several firms acting together can eliminate some or all of the competitors, the profits of those firms remaining in the field will be increased, although the combined profits from the reduced output may be less than the previous combined total profits. Thus, predatory tactics, aimed at the elimination of some or all rival producers in an industry are, if successful, always in the interest of the would-be monopolists; while voluntary cooperation in output restriction, through abandonment of some of the units, may or may not prove profitable. In either case, however, the locational results may be the same—a reduction in the number of producing locations.

B. Even to produce the same output (any given output), there might be substantially different locational forces operating in the more monopolistic situation. It is frequently argued that one of the "wastes of competition" is that competing firms are necessarily smaller than optimum size from a technical and managerial standpoint. Professor Chamberlin[4] very correctly points out that this is not a waste of competition but a waste of limited or "monopolistic" competition. In any case, an increased degree of monopoly, allowing for a smaller number of production units more efficiently to produce a given output, may eliminate this waste. That this result might well follow can be illustrated very simply. Suppose that plants under separate control are located 200 miles apart, selling over an intervening area. It may be that a new, independently controlled firm could locate midway between the existing units and get enough business to provide reasonable profits. This move will, of course, reduce the sales and the profits of the existing firms. An important possibility is that the combined reduction in their profits may be greater than the profits enjoyed by the new firm, simply because all three are now forced to operate at less than optimum size. Yet all three may continue to make sufficient profits to continue in operation. If the industry were under a single control, then fewer units, more widely spaced, and operating more nearly at the technical and administrative optimum size, would yield a larger combined profit from the same volume of production. Thus, the creation or existence of monopolistic controls may yield a smaller number of producing locations than would occur if the units were under separate direction.[5]

An excellent example of this effect is the location of gasoline stations and lunchrooms along the new Pennsylvania Turpike. These concessions were granted as monopolies. The result is that there are many fewer of each type of establishment than would have occurred had competitive enterprise been allowed on the high-

[3] See TNEC Hearings, part II, pp. 381–667. It has been suggested that a tie-up between the United Shoe Machinery Corporation and certain of the shoe manufacturing companies operates in a similar fashion to protect the areas in which the latter companies have plants from the "destructive" competition of too many producers. This means that production is less in certain areas than would be the case in the absence of the monopolistic controls.

[4] *Theory of Monopolistic Competition,* Harvard University Press, 1933, p. 109.

[5] It should be kept in mind that the greater production efficiency, and lower production costs, in the more monopolistic situation are no evidence of net public gain. Consumers in the middle region would gain from the new plant, by lower delivered prices, while consumers near the older plants would probably have only slightly, if at all, higher prices.

way; and each unit is of a more efficient size, and operates more nearly at its optimum scale than is usual for such establishments. In the ordinary competitive situation, price competition can never reduce the number of gasoline stations or lunchroom locations to permit more economical use of each. To attract to any given unit the additional customers necessary for more efficient operations or larger scale facilities would require price cuts greater than the reduction in unit costs secured by the larger volume. The reason for this inability of competitive units to operate at maximum efficiency in these fields is in part a result of the geographical scattering of customers, and of the partial monopoly which is granted by the fact that customers will buy from the nearest seller unless a more distant seller's price is sufficiently lower to compensate for the cost and inconvenience of added distance. If any person had been allowed to establish a gasoline station on the Pennsylvania Turnpike, there would have been more such stations than now exist, even if each had been required to sell the same gasoline, from identical facilities. The mere fact of geographical separation frequently makes competition "monopolistic," and prevents the realization of economies which full monopoly can achieve—economies which incidentally would reduce the number of producing locations.

An added factor in the above examples is the existence of various consumer preferences other than the natural preference for the nearest seller. This factor may operate independently of the geographical factor to preserve a large number of producing locations than would be utilized by a monopoly.

This may be the case with any consumers' goods of which many varieties are marketed, each under its own trade name, or under its own patented process. Common direction might reduce the number of varieties, allowing the production of each to take place in a plant of a technically more efficient size. Under separate control no producer is able to take advantage of the lower costs due to larger size, because to increase his sales by attracting customers attached to his rivals' varieties requires a price level reduced by more than what would be the resulting reduction in unit costs.[6] Unless the plants of the industry are highly localized, a reduction in the number of plants will probably mean a reduction in the number of producing locations. Examples of the purchase and closing down of competitors' plants can be found in many industries, essentially for the reasons herein set forth, e. g., shoes, rubber, tobacco, woolens, meat packing, etc.

C. Another difference in locational pulls, even for the production of the same output, would occur if common control meant the elimination of the cross-hauling of commodities (interpenetration of market areas) and the previous "cross-hauling" of sales efforts. Consider the case in which all firms are selling to all parts of a national market, securing such a market, if necessary, by "freight absorption." Under such circumstances, the locational pull of particular markets, or the decentralizing effects of a dispersed market, is reduced. Elimination of such competitive cross-hauling, through substitution of common management, would dictate a scattering of production units more nearly in accordance with the scatter of customers.[7]

D. Substitution of common for individual control may eliminate still another of the wastes of limited competition and again alter locational patterns. It may be that the more competitive structure compels each unit to maintain a diversified output, to meet the desire by consumers to purchase related goods from a single source. A single competing firm which attempted specialization to secure production economies would lose its customers. Combining the sales efforts under a single agency would allow greater functional specialization by the constituent production units. This increased specialization may have unfortunate results for the communities involved, such as the substitution of seasonally irregular for steady employment. This is the case of convergent complementary goods, discussed in the preceding chapter. But here there are not economies but diseconomies of the integration of related processes in a single plant, diseconomies forced upon the individual firm by competition, from which combination would release the constituent units. A similar case in which competition (of the monopolistic variety) may force uneconomic diversification involves the use of brand names. The extensive goodwill attached to a particular trade name, such as "Westinghouse," "Frigidaire," or "Del Monte," is a fixed asset, which can be spread over a large number of items at no increase in cost. Thus firms whose trade marks are well known find it profitable to expand into numerous lines to take the fullest possible advantage of their goodwill. In some cases this may mean that there are so many firms in each of a number of product lines that none can secure the full advantages of economy of scale for each product, and they are forced to produce several products in a single plant. Combination of the competing units and a reduction in the number of trade names would again allow a greater functional

[6] The increased efficiency due to the reduction in the number of varieties of the product is in the interest of the general body of consumers only if the markets of the individual varieties had been based on irrational preferences, perhaps stimulated or created by advertising.

[7] For fuller discussion of the effect of cross-hauling upon location, see chapter 18 below, where the locational effects of cross-hauling are compared with the locational effects of price policies which do not permit cross-hauling.

specialization by individual plants, with possible differences in the seasonal pattern of employment, and alterations in the locational requirements for particular types of labor, power, or materials.[8]

E. Monopolistic situations arise in other ways than through the consolidation or establishment of common control over a number of potentially competitive units. One very significant factor in the achievement of monopoly position is mere early entry into a new field, and the ability to hold that field against the possibility of any subsequent competition simply through continued technological advance. It is the firm already in the industry that is frequently although not invariably most likely to pioneer in technological improvements; and because of its earlier start and the protection offered by patents, it may be able to stay always far ahead of any potential competitors. Familiar instances occur in the fields of chemicals, business machines, cameras, sewing machines, artificial fibers, sleeping cars, optical supplies, and many others. In such cases locational cost differences may be far less significant than cost differences due to exclusive possession of particular processes. Even if it is unfavorably located, the position of the original firm cannot be challenged. It may never be forced to consider whether or not its location is the best possible one, or having discovered that it is not, it may prefer the continuance of operations at the old location to the necessary capital loss consequent upon movement. Many types of investment cannot be liquidated without severe loss, even over extremely long periods of time. To continue operations at all in a given plant requires constant reinvestment. Because of the lack of competition which would force the firm to accept this necessary capital loss, historical accident can determine location in the monopolized industry for an indefinite period of time.[9] However, if the industry in which the monopolist maintains his original primacy is a rapidly growing one, the above factor does not operate to prevent the decentralization of subsequent plant additions, if there are any advantages to such decentralization.

On the other hand, the fact of monopoly control may have the opposite effect—that of speeding rather than delaying locational change. Absence of competition may, and frequently does, allow management to afford the luxury of scientific study of locational problems, resulting not in locational immobility, but on the contrary in more perfect adjustment to the optimum location, and more rapid response to changing locational forces. The leadership in the movement into promising new industrial areas has frequently been taken by large corporations not burdened by intense competitive struggle, and possessing the financial resources which allow it to take a long range view.

Control of Associated Processes

Of the many considerations involved in the acquisition of control by owners of one production unit, or by the suppliers of a single service or resource, over related processes, those which affect location because they result in an actual economy of operations have been discussed in the preceding chapter. It was shown, for instance, that common control of vertically or horizontally linked operations might in some cases promote a locational integration which would not otherwise have taken place. In many cases firms or owners of firms engaged in one productive process extend their operations to related fields in order to take advantage of genuine economies of common administration (common production factors), common purchase of materials (divergent processes), or common use of market connections (convergent processes). Locational integration of the processes involved is sometimes necessary for the achievement of these economies—the economies of a common administration force, or of carload purchasing, for instance.

In other cases the economies which prompt the firm integration do not require locational integration—for example, the elimination of the expense of sales effort on the one hand, and of a purchasing division on the other. Likewise, locational integration is not required by firm integration which has the purpose of assuring a steady supply of the commodity or service to the previously independent buyer, and an assured market for the previously independent seller, simplifying problems of planning, and reducing the need for reserve inventories.

In still other instances, common control of related processes does not seem primarily to represent an attempt to secure production economies from the combination. The owners of the one unit, with surplus funds for investment, turn to a related field, e. g., the supplying of a raw material, simply because it is a field concerning which they have some knowledge, and with whose problems they feel somewhat familiar. Other instances of acquisition of control of related processes seem to reflect merely the desire of the owners to fill out the pattern of an industrial empire—the satisfaction or

[8] The reverse situation might occur if there are genuine production economies of joint production (e. g., utilization of byproducts), for which additional lines the single unit could not afford a specialized sales effort.

[9] The same generalizations would apply to a monopoly maintained by means of discrimination, rebates, and similar "unfair trade practices," or by means of firmly established "goodwill." In technical terms the argument is that the monopolist will not relocate unless his total costs at the new location are less than his variable costs at the old.

prestige which results from the control of a complete process. Finally there is the acquisition of control over entirely unrelated processes—or processes which are related only through the fact that all require capital (and hence the services of commercial and investment bankers) and all require some land and buildings.

But even where the establishment of common control involves no production economies, or economies which do not require locational integration for their achievement, locational effects may nevertheless occur. There are some industries for which many locations are equally satisfactory. The actual locations of units in these industries may be explainable only in terms of historical accident, or individual preferences. Locational concentration of such units or their locational integration with units of other industries is frequently the result of concentration of industrial ownership or control. The natural desire of owners or controllers of related or unrelated processes is to keep the operations in places where they, or their trusted lieutenants, can maintain a watchful eye over the proceedings. If the process itself is bound to a particular location, it may be that the administrative staffs, the sales offices, the official headquarters can be kept at hand for convenient scrutiny. Where the units controlled require large administrative staffs this concentration can have fairly significant locational implications. The concentration of the administrative organizations of the various Mellon interests in the city of Pittsburgh, for example, represents a not unimportant element in that city's economic life. It may represent an even more important deficiency in the lives of the localities where the actual productive processes take place. The decentralization of administrative functions would give greater stability of employment and of retail sales to the producing localities, for employment in administrative branches is less variable than in the producing divisions. Likewise the social and cultural advantages to the producing communities which would result from a population of more diversified interests and abilities are not to be ignored.

There is, clearly, the possibility that common control of related or even of unrelated industrial operations will cause some alteration of locational pattern, as compared with the result if the processes were separately directed. In each instance so far considered, this alteration of locational scatter either resulted in real economies, or at least had no necessary ill effects upon the profitability of the units so controlled. Undoubtedly, also, builders of industrial empires may in some cases sacrifice something in the way of maximum profits for the satisfaction of vanity and the desire for prestige. But in another major class of cases financial controls of business units may operate to alter locational patterns in a way which is definitely deleterious to the profits of some of the units involved.

Financial Controls

The term "financial controls" is here used in what is probably a specialized sense, to imply control without the major degree of beneficial ownership of the unit involved.[10] The result of such control may be the location of productive units at points where they would not have located had the control been exercised by the major beneficial owners. Location of units to serve in the interests of those wielding financial controls may also be in the interests of, or it may be at the expense of, the major beneficial owners of the controlled unit. Banker control of an industrial enterprise, for instance, is usually exerted with the interests of the controlled firm as the central consideration.

A commercial banker is concerned with protection of his loan; an investment banker with protection of his reputation and possible future commissions. If this is his interest, he will approve location or expansion of the firm at the most profitable site—that is, he will consider nearness to materials or market, costs of labor and power, and so on. Financial control thus appears not as a separate locational factor but simply as a stronger guarantee that the existing locational forces will be rightly gauged and their pull respected. But the perhaps rare exception in which financial controls operate as an independent force likewise deserves attention.

The functional connection among the units subject to common control in the interests of some of them but not of others may be of many kinds. It may, for instance, involve the rental or sale of land or buildings to a producing firm. Owners of land or buildings who have a voice in the control of a business firm may induce its location at a particular site which would otherwise have brought a lower return to its owners. If the land owners were also sole owners of the business firm, any real estate gain would be simply offset by a profits loss, assuming that the particular site is not the most advantageous site and that it would, therefore, not otherwise have been chosen. But if the land owner is only fractional owner of the business, his gain as a land owner may not be offset for him by a loss in profits. (If exact site is a matter of indifference, the gain to the individual is not offset by a loss

[10] No detailed exposition is required at this point as to the methods by which such financial controls without major ownership may be exerted. These methods are by now relatively familiar, after a decade or more of increased public interest in such affairs: The holding company device, the general dispersion of stockholding in many enterprises among thousands of small holders, and the proliferation of new types of nonvoting securities. The powers of control sometimes exerted by commercial and investment banks likewise can hardly be overestimated. In still other cases the control may be exerted through personal relationships among top-ranking officials.

to the firm.) The land owner would also benefit from the general appreciation of land values resulting from an influx of workers for a new firm, and the resulting possible establishment of subsidiary industries.

Similarly, financial control may be exerted to bring to a locality industries which will benefit existing local retailers, local producers of power or suppliers of other personal and public services, or to benefit existing local producers either by providing them with a market, or with a cheap, convenient source of supply. In several of the above instances, the locational integration might well be in the interests of each of the units individually, or in the interest of their combined profits if under single control. But, it must be emphasized, such locational integration may also be "artificial"—not in the interest of some one of the units involved.

The alteration in locational patterns caused by the existence of financial controls may not in all cases result in locational integration. It may prevent the locational integration of related processes where that integration is economically justified. For example, a firm may sell to or buy from a controlled but only partly owned subsidiary not because such subsidiary is so located that it can profitably offer the most favorable terms; the subsidiary may in part offer the most favorable terms only at the expense of its major owners. An independent producer whose location near to the purchaser or seller makes him best fitted to handle the business may be unable to remain in operation against such competition, and the genuine advantages of locational integration may thus be lost.

Summary

The discussion of the present chapter has demonstrated that the integration of related or unrelated processes within a single firm or within a single source of control may substantially affect the locational factors otherwise operative. The principal effect of monopolistic influences appears to be a reduction in the number of separate producing locations, especially where the monopolistic combination gives effective output control, or where monopoly is substituted for an inefficient competition which is already limited by transportation costs, consumer preferences, or a strong proprietary element. To the extent that the combination eliminates cross-hauling, it strengthens the force of the market as a location factor. Monopoly control may also mean that irrational forces, or the desire to protect existing investment, may for lengthy periods determine the pattern of location, by preventing or delaying the process of locational change.

The establishment of common control over producers of different commodities or services may allow production economies to be achieved through locational integration; even in the absence of such economies, locational integration may be the result of such controls. Common control which involves exploitation of some of the units may cause disregard for locational cost differences, and warp locational patterns either in the direction of locational integration or locational scatter of the units.

CHAPTER 17. SMALL MANUFACTURING FIRMS

By Edna Sugihara*

The three preceding chapters have discussed the relationships between locational factors and varying sizes and levels of industrial organizations, and have, therefore, indicated in a general way the more important locational needs of small-scale industrial units. The previous discussion, however, was not concerned particularly with small, independently owned and operated manufacturing units as differentiated from small technical units, i. e., branch plants of large firms. The former group and its relations to locational policy are treated in this chapter.

The view is widely held that major changes in the locational distribution of manufacturing will prove advantageous to small firms. The assumptions underlying this view may be summarized thus: (1) because of various handicaps, small firms are faring badly; (2) they are important in the economy and should be given assistance; and (3) the difficulties facing small firms can be alleviated by changes in the present geographic distribution of industry, especially by a growth of decentralization and diversification.

From the standpoint of evolving a locational policy which will promote the most efficient utilization of industrial resources, it is as essential to examine the implications of the first two assumptions as it is to determine the validity of the third. In fact, the necessity of considering small firms within the framework of locational or other governmental policies is often denied because the first two propositions are not accepted. Therefore, a more precise statement of the issues involved seems necessary.

That small firms as a group are facing difficulties in maintaining their position in the economy is not disputed. But as to the nature of their chief difficulties, views differ. There are those who contend that technology has revolutionized the basis for production to such an extent that small-scale operations are no longer efficient. According to this reasoning, the difficulties of small firms are largely manifestations of their inefficiency, and attempts through governmental policy to assist such firms would only perpetuate uneconomic units. However, those who advocate such measures as decentralization or diversification presuppose the basic efficiency of small-scale units in most areas of manufacturing. It is maintained that their difficulties are due not to technological advance but to various "unfair" obstacles. Hence, any costs incurred in removing the obstacles are considered justifiable since a less wasteful economy would result.

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Even casual observation warns us that the whole truth is not contained in either of these extreme views. Many small firms have failed because technical and managerial innovations have permitted large-scale operations to be more economical; others have become business casualties for reasons quite remote from technological displacement. The fundamental question to be answered, therefore, is not whether small firms as such are indispensable, but rather in what specific areas of manufacturing their retention is important because small-scale operations are most efficient.[1]

If these can be ascertained, then the task for locational planners includes consideration of the present geographic pattern of efficient small firms, the most urgent problems faced by such firms, the feasibility and/or desirability of seeking solutions for those problems through locational policy. In this study because of the scantiness of available data and the use of very rough methods of analysis, the procedure outlined can be followed only in the most general manner.

Economic Significance of Small Manufacturing Firms

Despite frequent references to "small firms" or "small business", there are wide differences of opinion on the number of such firms and, therefore, on the extent of their contribution to manufacturing. This is chiefly due to the fact that "small" is both a relative and an absolute concept. For example, the character of the "small business" group is obviously greatly changed if relatively small firms in industries like cigarette manufacturing, which require a minimum of a few hundred employees, are included with small firms such as those in garment manufacturing, employing perhaps ten or twelve persons.

For the purpose of this study, it seems desirable to establish some absolute standard, which can be applied to all manufacturing, since most of the problems of small firms apply to all firms within a certain size-range, regardless of their relative size within a particu-

[1] Small-scale enterprise is also defended for the sake of intangible considerations (such as the preservation of individual initiative and incentives for progress), but these are highly subjective factors which cannot be properly evaluated.

lar industry. Moreover, locational changes such as decentralization or diversification are not proposed for the benefit of "relatively small" firms but for a host of existing and potential firms of a limited size.

The selection of criteria for a standard is a difficult task. In the first place, what is to serve as the common measure? The number of wage earners employed, net worth, value of product, as well as any of various other criteria, might be chosen. Secondly, the upper limit of the class of small firms must be determined no matter what measure is used. Ideally, one basis for measurement should be selected or devised, but the statistical data in this field are so limited that it is necessary to employ a variety of measures, and, in each case, to decide arbitrarily the dividing line between small firms and others. There will be differences in the composition of small firms as defined by the various methods, but the differences are not likely to be so great that general deductions cannot be drawn.

The most comprehensive data on manufacturing are assembled by the Bureau of the Census, but, unfortunately for our purposes, the basic unit for which information is gathered is the establishment or plant, and not the firm. According to these "unadjusted" data, 83 percent of all establishments with products valued at more than $5,000 employed an average of 50 wage earners or less per establishment in 1937. Almost 70 percent employed an average of not more than 20 wage earners each.[2] These ratios, however, do not represent the actual proportion of small firms among the total number of manufacturing concerns for the reason that both small and large establishments may be units within a large firm.

A better picture of the proportion of firms that are small can be obtained from table 1. As a result of a special tabulation of the census data by the Department of Commerce, information is available on the average number of wage earners employed in independent and in "central-office operated" establishments for broad industry groups and the proportion of the number of establishments under both types of ownership.[3] If all manufacturing establishments are taken together, it can be seen that about 85 percent are independently operated and that they employ an average of only 30 wage earners per establishment.[4] There is, however, among the various industry groups, considerable variation in the proportion of establishments which are independently owned as well as marked differences in their average size.

TABLE 1.—*Average number of wage earners in independent and central-office operated establishments and the percentage of all establishments operated independently and by central offices in 1937* [1]

Industry group	Percentage of total establishments		Average number of wage earners per establishment	
	Independent	Central-office operated	Independent	Central-office operated
All industries	84.6	15.4	30	170
Printing, publishing, and allied industries	96.0	4.0	13	82
Miscellaneous industries	91.5	8.5	23	169
Nonferrous metals and their products	91.1	8.9	28	283
Textiles and their products	86.9	13.1	60	276
Forest products	86.0	14.0	30	92
Machinery, not including transportation equipment	85.6	14.4	51	363
Leather and its manufactures	85.0	15.0	66	287
Iron and steel and their products, not including machinery	81.8	18.2	62	491
Food and kindred products	81.0	19.0	12	46
Stone, clay, and glass products	78.2	21.8	29	123
Rubber products	77.0	23.0	112	805
Transportation equipment, air, land, and water	76.4	23.6	85	1,083
Paper and allied products	68.6	31.4	57	152
Chemicals and allied products	68.4	31.6	18	96
Products of petroleum and coal	51.7	48.3	31	294

[1] Derived from tables 2 and 8, Willard L. Thorp and others, *The Structure of Industry*, Temporary National Economic Committee, Monograph No. 27, 1941, pp. 114 and 128.

In the printing and publishing, nonferrous metals and products, and miscellaneous industries groups, over 90 percent of all the establishments were independently owned. On the other hand, in six major industry groups, namely, petroleum and coal products, chemicals and allied products, paper and allied products, transportation equipment, rubber products, and stone, glass, and clay products, from one-fifth to almost one-half of the plants were units of multiple-plant firms.

A single-plant firm is not, of course, necessarily a small firm. The fact that the average number of wage earners in the rubber products industries was 112 probably signifies that some independent plants in this industry were quite large.[5] However, with this and other reservations which must accompany the use of averages covering such large groups, we can obtain some notion of the proportion of firms that may be considered small.

According to the Department of Commerce study, there were in 1937, 141,905 single-plant firms controlling or owning 84.6 percent of all manufacturing establishments and 5,625 central-office firms controlling or owning the remaining 15.4 percent.[6] Thus, single-plant or independent firms constituted about 85 percent of all firms, employed an average of from 12 to 112 wage earners per firm among the various industry

[2] Bureau of the Census, *Statistical Abstract of the United States*, 1939, p. 773.

[3] The tabulation was made by Willard L. Thorp and others, *The Structure of Industry*, Temporary National Economic Committee, Monograph No. 27, 1941.

"Central-office operated" establishments include those under central control as well as those centrally owned. *Ibid.*, p. 107.

[4] These data also exclude marginal and part-time enterprises, all those whose total value of product was less than $5,000.

[5] Nor does multiple-plant operation necessarily mean that the individual plants are large. This is particularly evident in the food products group in which the centrally owned establishments employed an average of only 46 wage earners each.

[6] Thorp and others, *op. cit.*, pp. 128 and 152.

groups, and accounted for a little less than 50 percent of the average number of all manufacturing wage earners during the year.[7] From these data a rough guess may be ventured that from 80 to 90 percent of all manufacturing firms employed not more than 50 to 75 wage earners each and that such firms accounted for from one-third to two-fifths of the wage-earner personnel in manufacturing.

The economic position of small enterprises in manufacturing cannot be inferred from the number of units alone. The proportion of the total volume of production contributed by small firms is a necessary supplementary measure. In 1937, the single-plant firms accounted for a little less than 40 percent of the total value of products.[8] However, as indicated above, the data on single-plant concerns overstate the contribution of small firms since one-plant enterprises are sometimes quite large. The only statistics available on the volume of business done by various sizes of firms are for corporations as compiled by the Bureau of Internal Revenue. But it should be noted that these data err in the opposite direction by greatly understating the importance of the small business sector of manufacturing. Many small firms are proprietorships or partnerships while the large units are almost wholly incorporated.

In table 2 corporations in the major industry groups[9] are classified in three asset classes; the number of firm units and the gross sales of each component class are given. The three asset groupings were arbitrarily made to represent small, medium-sized, and large corporations. It will be seen that, in manufacturing as a whole, small corporations in 1937 composed 80.8 percent of the total number of corporations but accounted for only 13.1 percent of the gross sales. There was considerable divergence from these averages, however, particularly in the proportion of gross sales accounted for by the small corporations.

The industry groups in table 2 are ranked, in descending order, according to the share of small corporations in the volume of sales within each group. In the clothing and apparel group, the small corporations accounted for about 40 percent more of the gross sales within the group than did the small units within manufacturing as a whole. In the next three categories, namely, forest products, leather and its manufactures, and printing, publishing, and allied industries, the share of the small corporations exceeded the over-all average by 16, 13, and 12 percent, respectively. Reading from the bottom of the table, however, it can be noted that in many groups, the small units manufactured a very small portion of the total product. In the petroleum and other mineral oil products, motor vehicles, tobacco products, and rubber products groups, the percentage of gross sales accounted for by small corporations was in each case less than one-

TABLE 2.—*Number of manufacturing corporations and their gross sales, by major asset classes and by major industrial groups, as of Dec. 31, 1937*

Industry groups, assets classes	Corporations		Gross sales	
	Number	Percent of total	Amount (thousands)	Percent of total
All manufacturing	85, 471	100. 0	$59, 375, 402	100. 0
Under $250,000	69, 058	80. 8	7, 742, 982	13. 1
$250,000 and under $5,000,000	15, 154	17. 7	18, 900, 465	31. 8
$5,000,000 and over	1, 262	1. 5	32, 731, 955	55. 1
Clothing and apparel	7, 319	100. 0	2, 136, 812	100. 0
Under $250,000	6, 740	92. 1	1, 142, 705	53. 5
$250,000 and under $5,000,000	567	7. 7	850, 818	39. 8
$5,000,000 and over	12	. 2	143, 289	6. 7
Forest products	6, 072	100. 0	1, 821, 166	100. 0
Under $250,000	4, 768	78. 5	524, 532	28. 8
$250,000 and under $5,000,000	1, 240	20. 4	913, 022	51. 8
$5,000,000 and over	64	1. 1	353, 612	19. 4
Leather and its manufactures	2, 212	100. 0	1, 294, 690	100. 0
Under $250,000	1, 783	80. 6	335, 179	25. 9
$250,000 and under $5,000,000	408	18. 4	607, 200	46. 9
$5,000,000 and over	21	. 9	352, 211	27. 2
Printing, publishing, and allied industries	11, 052	100. 0	2, 153, 472	100. 0
Under $250,000	9, 866	89. 3	546, 231	25. 4
$250,000 and under $5,000,000	1, 109	10. 0	971, 722	45. 1
$5,000,000 and over	77	. 7	635, 519	29. 5
Manufacturing, not elsewhere classified	5, 070	100. 0	1, 762, 392	100. 0
Under $250,000	4, 339	85. 6	371, 141	21. 1
$250,000 and under $5,000,000	689	13. 6	754, 029	42. 8
$5,000,000 and over	42	. 8	637, 222	36. 1
Textile mill products	7, 128	100. 0	4, 343, 599	100. 0
Under $250,000	5, 292	74. 2	702, 277	16. 2
$250,000 and under $5,000,000	1, 709	24. 0	2, 260, 117	52. 0
$5,000,000 and over	127	1. 8	1, 381, 205	31. 8
Stone, clay and glass products	3, 684	100. 0	1, 460, 314	100. 0
Under $250,000	2, 915	79. 1	198, 601	13. 6
$250,000 and under $5,000,000	704	19. 1	490, 511	33. 6
$5,000,000 and over	65	1. 8	771, 202	52. 8
Liquors and beverages	2, 876	100. 0	1, 742, 769	100. 0
Under $250,000	2, 134	74. 2	237, 789	13. 6
$250,000 and under $5,000,000	703	24. 4	883, 382	50. 7
$5,000,000 and over	39	1. 4	621, 598	35. 7
Food and kindred products	11, 110	100. 0	10, 500, 786	100. 0
Under $250,000	9, 130	82. 2	1, 412, 674	13. 5
$250,000 and under $5,000,000	1, 850	16. 7	3, 221, 436	30. 7
$5,000,000 and over	130	1. 2	5, 866, 676	55. 9
Paper, pulp, and products	2, 169	100. 0	1, 793, 534	100. 0
Under $250,000	1, 438	66. 3	205, 052	11. 4
$250,000 and under $5,000,000	656	30. 2	819, 521	45. 7
$5,000,000 and over	75	3. 5	768, 961	42. 9
Chemicals and allied products	6, 220	100. 0	4, 007, 778	100. 0
Under $250,000	5, 017	80. 7	421, 917	10. 5
$250,000 and under $5,000,000	1, 080	17. 4	1, 189, 186	29. 7
$5,000,000 and over	123	2. 0	2, 396, 675	59. 8
Metal and its products	18, 252	100. 0	14, 593, 485	100. 0
Under $250,000	14, 080	77. 1	1, 442, 888	9. 9
$250,000 and under $5,000,000	3, 829	21. 0	4, 754, 819	32. 6
$5,000,000 snd over	343	1. 9	8, 395, 778	57. 5
Rubber products	586	100. 0	1, 053, 576	100. 0
Under $250,000	401	68. 4	53, 899	5. 1
$250,000 and under $5,000,000	160	27. 3	241, 057	22. 9
$5,000,000 and over	25	4. 3	758, 620	72. 0
Tobacco products	323	100. 0	1, 277, 403	100. 0
Under $250,000	236	73. 1	25, 311	2. 0
$250,000 and under $5,000,000	67	20. 7	81, 881	6. 4
$5,000,000 and over	20	6. 2	1, 170, 211	91. 6
Motor vehicles, complete or parts	759	100. 0	4, 620, 272	100. 0
Under $250,000	521	68. 6	63, 871	1. 4
$250,000 and under $5,000,000	200	26. 4	416, 341	9. 0
$5,000,000 and over	38	5. 0	4, 140, 060	89. 6
Petroleum and other mineral oil products	642	100. 0	4, 813, 354	100. 0
Under $250,000	398	62. 0	58, 915	1. 2
$250,000 and under $5,000,000	183	28. 5	394, 574	8. 2
$5,000,000 and over	61	9. 5	4, 359, 865	90. 6

Source: U. S. Bureau of Internal Revenue, *Statistics of Income for 1937*, pt. II, pp. 93-126.

[7] The independent firms employed an average of 4,189,108 wage earners out of a total of 8,569,231. *Ibid.*, pp. 127–128.

[8] *Ibid.*, p. 133.

[9] These are not comparable with the industry classifications given in table 1 which were Bureau of the Census data. The reporting unit to the Bureau of Census is the plant or establishment while the unit employed in the Treasury figures is the corporation. In each case, the basic unit is classified in an industry according to the most important product (measured in value terms) of the unit. Under these circumstances, it is apparent that the Census data relate more closely to the actual industry groupings than do those given in the Treasury reports.

half the proportion attributable to small corporations in all manufacturing.

Industries in Which Small Firms Predominate

The foregoing discussion has indicated the over-all significance of small firms in manufacturing today, but the chief task of this portion of the chapter is to determine the specific areas in which small firms can operate efficiently. It is evident that this cannot be satisfactorily accomplished by mere opinion or conjecture. On the other hand, the scientific measurement of the efficiency of business organizations is extremely difficult since efficiency is an economic concept not easily reducible to statistical terms. Even though measurement were feasible, a firm-by-firm survey of all manufacturing concerns presents a problem of staggering proportions. Obviously, these difficulties cannot be overcome within the narrow scope of this study.

However, if the problem is not to be left in the purely speculative realm, it seems advisable to settle upon some rule-of-thumb procedure which will enable us to indicate roughly the areas where small-sized firms are likely to be the most efficient. The preceding data on corporations indicate that in some broad sectors of industry small firms are not only numerically large but they account for a considerable bulk of the manufactured products sold. From this, it can be inferred that small-scale operations are more suited to some kinds of manufacturing than to others. It seems justifiable to assume also that if small firms conduct all or a preponderant portion of the manufacturing activity within specific industries they do so because small-scale units are still the most efficient. An attempt will, therefore, be made to distinguish specific industries in which small enterprises predominate, and thus the industries in which smallness apparently has economic advantages.[10]

This procedure would be relatively simple if data were available on small firms as such. But, as indicated previously, the manufacturing census data relate to establishments and not to firms, and corporation statistics are not published for other than the major industry groups. A somewhat circuitous method must be followed, therefore, in identifying small-firm industries.

Information is available on the general characteristics of the eight largest producers in each of 275 census classifications, i. e., number of establishments owned, number of wage earners employed, value of product, etc., from a study of the National Resources Committee (predecessor to the National Resources Planning Board) for 1935.[11] The industries shown in tables 3 and 4 were selected by employing arbitrary criteria to segregate industries in which the eight major producers were not dominant and in which the largest number of small producers was likely to appear. No industry was listed in either group if the eight largest producers owned more than 10 percent of the total number of establishments in the industry.

Table 3 further excludes industries in which more than 30 percent of the value of product was accounted for by the eight largest producers. The sizes of the leading establishments, as measured by the number of wage earners employed, ranged from an average of 6 in cheese manufacture to 974 in cotton manufactures. The scope of operation of the largest producers in terms of the number of establishments owned also varied considerably, from 8 establishments, or one each, in the production of jewelry, leather gloves and mittens, leather goods, brooms, and fur goods to 348 in the bread and bakery products industry. Although both plants and firms can evidently be large in some of these industries, the fact that the largest concerns did not produce more than 30 percent of the total product suggests that smaller firms are able to compete effectively.[12] It must be pointed out, however, that since this procedure does not exclude industries in which firm size is relatively uniform, some of those listed may not in fact be small-firm industries.

The industries shown in table 4 are restricted to those in which the eight major producers owned less than 10 percent of the establishments, operated one plant or an average of two plants, and employed less than an average of 200 wage earners per plant. This group appears to be completely the domain of small enterprises, since even the largest producers are relatively small firms. In over half of the industries listed, the major producers accounted for more than 30 percent of the value of product of the industry, but they achieved their position in the market with a relatively small single plant, or with not more than two small plants.

Some major qualifications must be made regarding the validity of the procedure followed above in determining the areas where small firms are dominant. First, the selection of industries in which the eight major producers owned less than 10 percent of the establishments, as a first step, was quite arbitrary.

[10] The error in this approach may be due to over-conservatism rather than the reverse, since the tendency to expand firm size is frequently due to considerations other than efficiency. See chapter 14.

[11] National Resources Committee, *The Structure of the American Economy, Part 1, Basic Characteristics*, June 1939, pp. 249–259.

[12] It should be noted that the number of wage earners is not a completely satisfactory measure of firm size, since the degree of mechanization differs greatly among industries and among firms in the same industry. Where conditions warrant, it is conceivable that a very large firm would rely so heavily on machinery that the actual number of wage earners would approximate the number employed by a much smaller firm.

TABLE 3.—*Industries in which the 8 largest producers in 1935*[1] *owned less than 10 percent of the number of establishments and accounted for less than 30 percent of the value of product*

Industry	Establishments: Number owned	Establishments: Percent of number in industry	Average number of wage earners in establishments owned	Percent of value of product of industry
Cotton manufactures	58	4.7	974	14.4
Dyeing and finishing cotton, rayon, and silk	17	3.3	937	22.3
Knit goods	26	1.4	738	8.5
Rubber goods other than tires, inner tubes, and boots and shoes	15	3.6	703	28.5
Rayon manufactures	27	6.0	677	27.1
Pottery, including porcelain ware	12	4.7	675	29.1
Machine tools	9	3.5	668	23.5
Lumber and timber products	26	.4	631	7.6
Stamped and pressed metal products, enameling, japanning, and lacquering	12	1.7	616	18.6
Men's, youths', and boys' clothing, n. e. c	20	.7	570	8.8
Machinery, n. e. c	23	.9	565	11.0
Machine shops	20	.7	557	14.6
Stoves and ranges (other than electric) and warm-air furnaces	15	2.7	555	23.0
Confectionery	16	1.2	517	19.9
Silk manufactures	11	1.7	511	18.5
Furniture including store and office fixtures	22	.7	491	8.8
Liquors, malt	11	1.7	472	17.7
Women's, misses', and children's apparel, n. e. c	19	.2	435	2.4
Printing and publishing, newspaper and periodical	59	.7	379	25.5
Jewelry	8	.8	372	15.4
Toys, n. e. c., games, and playground equipment	11	2.9	365	25.6
Furnishing goods, men's	8	1.0	329	13.0
Lithographing	14	3.6	305	22.4
Gloves and mittens, leather	8	3.6	304	23.2
Men's cotton garments	72	6.1	291	16.9
Paper goods, n. e. c	22	4.0	271	23.7
Miscellaneous articles, n. e. c	10	1.5	247	18.7
Book binding and blank book making	14	1.4	243	20.6
Wood turned and shaped and other wooden goods, n. e. c	27	3.6	224	28.6
Trunks, suitcases and bags	10	3.2	191	26.4
Buttons	15	5.1	180	27.0
Pocketbooks, purses, and cardcases	9	2.8	177	15.8
Macaroni, spaghetti, vermicelli, and noodles	9	2.7	169	26.4
Leather goods, n. e. c	8	2.0	168	26.5
Baskets and rattan and willow ware, not incl. furniture	14	6.9	159	25.6
Printing and publishing, book, music, and job	53	.5	158	6.5
Clay products (other than pottery) and non clay refactories	63	5.9	145	26.6
Boxes, paper, n. e. c	52	4.3	142	20.7
Bread and other bakery products	348	1.8	139	25.6
Brooms	8	2.3	131	23.0
Planing-mill products (incl. general millwork), made in planing mills not connected with sawmills	29	1.1	128	8.1
Photo-engraving, not done in printing establishments	13	2.0	126	20.2
Caskets, coffins, burial cases, and other morticians' goods	30	5.5	121	23.5
Waste and related products	16	5.1	105	24.1
Marble, granite, slate, and other stone, cut and shaped	24	1.7	104	13.9
Electroplating	11	2.0	93	17.7
Boxes, wooden, except cigar boxes	51	7.7	76	21.8
Embroideries, trimmings (not made in textile mills), etc	10	.9	76	14.7
Sheet metal work, not specifically classified	39	2.8	64	26.4
Models and patterns, not incl. paper patterns	10	1.7	58	16.7
Fur goods	8	.4	54	4.5
Hand stamps and stencils and brands	15	5.4	50	28.9
Insecticides, and fungicides, n. e. c	14	2.6	46	27.1
Signs and advertising novelties	51	4.7	45	14.7
Butter	244	7.0	21	25.7
Concrete products	44	3.6	17	15.3
Beverages, non-alcoholic	87	2.7	13	13.2
Cheese	189	7.3	6	22.5

Source: National Resources Committees, *The Structure of the American Economy, Part 1. Basic Characteristics*, June 1939, pp. 249-59.

[1] Those which ranked highest in value of product.

It was felt, however, that industries in which the major producers owned a much greater proportion than 10 percent would more likely be generally characterized by centralized ownership and branch plant operations. The choice of a figure as low as 10 percent, on the other hand, has increased the possibility of having excluded: (1) industries in which there are a relatively small number of establishments and in which the major producers are small; and (2) industries in which there are a great many establishments so that the relatively high *proportion* owned by large producers still leaves room for a great *number* of small firms. Some examples of the first are given in table 5, while an illustration of the second is ice manufacturing.[13]

Second, in table 3, the elimination, from the first group, of industries in which the major producers accounted for more than 30 percent of the value of product in the industry is, again, more or less arbitrary, but the reasoning is that as the percentage share of the largest producers increases, the less likelihood there is that smaller producers are important in the industry. This procedure, however, excludes industries like flour and other grain mill products in which there are a large number of small producers

TABLE 4.—*Industries in which the 8 largest producers in 1935*[1] *owned less than 10 percent of the establishments, owned not more than 16 plants and employed less than 200 wage earners per plant*

Industry	Establishments: Number owned	Establishments: Percent of number in industry	Average number of wage earners in establishments owned	Percent of value of products of industry
Beauty-shop equipment, except furniture	8	9.8	148	59.2
Musical instruments and parts and materials, n. e. c	8	8.6	178	54.6
Flavoring extracts, flavoring syrups, and related products	16	3.9	39	54.0
Belting and packing, leather	10	5.3	122	53.4
Blacking, stains, and dressings	9	5.4	77	50.3
Doors, shutters, and window sash and frames, molding and trim, metal	12	9.0	178	49.0
Statuary and art goods (except concrete) factory products	8	7.6	32	46.1
Stereotyping and electrotyping, not done in printing establishments	16	7.8	93	46.0
Umbrellas, parasols, and canes	8	9.6	143	43.9
Windows and door screens and weather strip	10	7.1	79	41.0
Furs, dressed and dyed	16	9.6	151	40.1
Lubricating greases, not made in petroleum refineries	13	7.2	56	40.1
Engraving, steel, copperplate, and wood and plate printing	10	2.6	183	40.0
Cleaning and polishing preparations	8	2.0	93	39.9
Saddlery, harness and whips	8	5.0	151	37.8
Liquors, vinous	11	3.5	63	37.6
Artificial and preserved flowers and plants	9	4.7	116	35.2
Mirror and picture frames	8	4.7	95	31.2
Hand stamps and stencils and brands	15	5.4	50	28.9
Insecticides and fungicides, n. e. c	14	2.6	46	27.1
Buttons	15	5.1	180	27.0
Leather goods, n. e. c	8	2.0	168	26.5
Trunks, suitcases, and bags	10	3.2	191	26.4
Macaroni, spaghetti, vermicelli, and noodles	9	2.7	169	26.4
Baskets and rattan and willow ware, not including furniture	14	6.9	159	25.6
Waste and related products	16	5.1	105	24.1
Brooms	8	2.3	131	23.0
Photo-engraving, not done in printing estab.	13	2.0	126	20.2
Electroplating	11	2.0	93	17.7
Models and patterns, not incl. paper patterns	10	1.7	58	16.7
Pocketbooks, purses, and cardcases	9	2.8	177	15.8
Embroideries, trimming (not made in textile mills) etc	10	.9	76	14.7
Fur goods	8	.4	54	4.5

Source: Compiled from National Resources Committee, *Structure of the American Economy, Part 1. Basic Characteristics*, June 1939, pp. 249-59.

[1] Those which ranked highest in value of product.

[13] In 1935, the eight major producers owned 563 establishments, which was 14.6 percent of the total number of establishments in the industry. National Resources Committee, op. cit., p. 251.

but which is dominated in the market by extremely large producers.[14]

Third, the variations in products and sizes of firms are obscured when wide industry classifications are used. If narrower breakdowns had been available in the original data, a better picture of the areas in which small firms predominate could have been obtained. This is evident to some extent in table 5, which is taken from another source than tables 3 and 4. The general category of "knit goods" in table 3 includes hosiery, knitted cloth, knitted outerwear, and knitted underwear.[15] The last classification probably contains by far the largest producers since the products are relatively standardized, not greatly subject to style, and can be manufactured in plants outside the highly concentrated industrial areas. On the other hand, as shown in table 5, knitted outerwear is made entirely by small producers since the products are highly specialized and must be made close to the spot market as in the case of other style garments.

TABLE 5.—*Industries in which no establishments are controlled by central offices, with number of establishments, average number of wage earners, and value of products, 1937*

Industry	Number of establishments	Wage earners average for the year	Value of products (thousand dollars)
Billiard and pool tables, bowling alleys, and accessories	23	530	5, 547
Blouses, women's, misses', and children's—contract factories	64	2, 554	2, 435
Carpets and rugs, rag	35	429	1, 336
China firing and decorating, not done in potteries	16	306	1, 690
Engraving (other than steel, copperplate, or wood), chasing, etching, and diesinking	77	2, 152	8, 881
Feathers, plumes, and manufactures thereof	61	559	2, 320
Fur goods—contract factories	52	154	634
Furnishing goods, men's, n.e.c.—contract factories	31	759	854
Hair work	35	434	2, 449
Handkerchiefs—contract factories	16	932	944
Knitted outerwear—contract factories	164	2, 715	4, 592
Lapidary work	51	217	4, 391
Millinery—contract factories	32	239	697
Statuary and art goods (except concrete), factory production	99	858	3, 331
Wool scouring	20	1, 252	4, 550

Source: Thorp and others, *op. cit.*, p. 226.

Locational Characteristics of Small Industries

There is even less information on the location of small firms than there is on their other industrial characteristics.[16] Consequently, clues to the geographical distribution of small firms must be obtained indirectly, i. e., through such data as are available on the location of industries in which small firms apparently predominate. The unavoidable inaccuracies which occur in using relatively broad industrial categories in defining areas of small-firm predominance, as well as the roughness of the method of selecting the areas, must be remembered in translating the locational characteristics of entire industries into those of small firms.

Group I

Of the 58 industries listed in table 3, 20 were included in a study of the regional distribution of wage earners in selected industries and their distribution according to various types of areas for 1929 and 1933.[17] While more recent data on the distribution of wage earners by regions can be obtained from the biennial Censuses of Manufactures, no later information is available on their distribution by types of areas. For the latter, therefore, the description of this group of industries (arbitrarily segregated as group I)[18] relies heavily on the findings of the early study.

Four of the 21 industries are highly concentrated in the principal cities of industrial areas, with sparse representation in other types of communities. This group includes women's clothing; men's clothing; printing and publishing, book, music, and job; and confectionery.

The largest concentration of women's clothing firms is found in the New York City metropolitan area where the immediate market for their products exists. Style changes as well as seasonal changes in the character of the product and the necessity for specialization keep firms small. Since space requirements are nonspecialized and small, the most advantageous location is in New York City, where not only the market, but the necessary reserves of skilled labor and auxiliary services and industries exist. In recent years, there has been a tendency for the industry to disperse from the center of localization into contiguous areas, particularly in the case of the more standardized products such as house dresses, uniforms, etc. There is also a sizable concentration of such firms in the area surrounding Chicago. The only style center outside of

[14] In 1935, the eight major producers owned 93 establishments, which was only 4.2 percent of the total number of establishments, but they accounted for 37 percent of the value of product. *Ibid.*, p. 251.

[15] U. S. Department of Commerce, *Biennial Census of Manufactures*, 1935, p. 331.

[16] Even the available statistics on plants do not include data on the geographic distribution of the various sizes of plants in each industry, so the discussion is necessarily confined to the locational characteristics of the industries in their entirety.

[17] By Daniel Creamer. See Carter Goodrich, *et al. Migration and Economic Opportunity*, University of Pennsylvania Press, Philadelphia, 1936, p. 300–392, 708–734.

The types of areas include: (1) industrial—principal cities of industrial areas, large satellite cities in industrial areas, remainder of the industrial areas, cities of 100,000 or more inhabitants outside of industrial areas, remainder of counties in which such cities are located, important industrial counties without a city as large as 100,000 population; and (2) nonindustrial—remainder of the United States. *Ibid.*, p. 320.

[18] Dyeing and finishing of textiles, cotton goods, knit goods, rayon and silk manufactures, pottery, machine tools, lumber and timber products, stamped and enameled metal products, men's clothing, women's clothing, men's shirts, stoves and ranges, confectionery, furniture, printing and publishing (book, music, and job), printing and publishing (newspaper and periodical), clay products, paper boxes, planing mill products, bread and bakery products.

New York City is the one developing in Los Angeles, which specializes in clothing for warmer climates.

Since men's clothing is far more standardized than women's clothing, the firms engaged in men's clothing manufacturing have been much less confined to the New York City industrial area. Moreover, the contract shops in the industry do not have to maintain showrooms so that labor cost has a dominant influence on location. Thus, lower labor costs in the Middle Atlantic and East North Central regions have constituted a major attraction to the industry.

The concentration of job printing in the large cities can be explained by the fact that it possesses many features of a service trade, and the chief consumers of its products are the commercial and financial institutions resident in the metropolitan centers. Job printing of a standardized character need not be as close to the market, and thus tends to be diffused. Book printing has different characteristics, but since most of the editorial offices are located in the large cities, the printing establishments tend to be similarly distributed.

The confectionery industry is also highly localized in the large cities, which constitute its chief markets. The semiperishable character of a large portion of its products and the necessity to draw heavily on unskilled women workers during peak seasons make the centers of population the most desirable locations.

Two industries are less strictly confined to the principal cities but are for the most part located within industrial areas.

The stamped and enameled metal products industry has a primary concentration in the principal cities which compose the market foci, and a secondary concentration in the industrial peripheries near the source of materials. The Middle Atlantic and East North Central regions account for the largest numbers of wage earners in the industry.

Firms engaged in dyeing and finishing of cotton, rayon, and silk are located chiefly in the Middle Atlantic, New England, and South Atlantic States, and, for the most part, close to the largest markets for the fabric materials. In the northern areas, the chief concentrations of wage earners are found in the industrial peripheries, with secondary concentrations in the principal cities. Since seasonal fluctuations in this industry are not as great as those in the garment industries, and it does not have to sell in a spot market, it can locate more advantageously in areas adjacent to the garment centers where ample quarters at lower rents are available. In the South, however, the wage earners are found largely in nonindustrial areas, where cotton manufacturing has also tended to locate.

Nine industries with primary concentrations in industrial areas have important secondary concentrations in nonindustrial areas. They are men's shirts (included with collars and work clothing in "men's cotton garments" in table 3), knit goods, rayon and silk manufactures (listed separately in table 3, but grouped together in the 1933 census), pottery, machine tools, stoves and ranges, newspaper and periodical printing and publishing, paper boxes, and bread and bakery products.

Roughly, half the wage earners in the men's shirt industry (exclusive of work shirts and clothing) is found in the Middle Atlantic States. The work is done largely in contract shops which do not assume ownership of the materials so that labor is the most important cost item. The presence of firms in nonindustrial areas can be attributed to the exodus of small contractors to low labor-cost districts, particularly to the industrial and mining counties of Pennsylvania, where the exploitation of female labor was possible. On the other hand, the inducement of lower labor cost in nonindustrial areas is offset by the necessity of maintaining contact with jobbers, usually located in New York.

The New England, Middle Atlantic, and East North Central States accounted for somewhat more than 50 percent of the wage earners in the knit goods industry in 1939, while the bulk of the remainder was in the South. Within this category, the full-fashioned hosiery manufacturers as well as the manufacturers of fashion goods (outerwear and certain types of knitted cloth) tend to be concentrated in the cities and industrial peripheries of the North. The production of seamless hosiery, underwear, and other articles less affected by style occurs in relatively larger plants in nonindustrial areas of the North and the South where lower labor costs prevail.

The original locations of the rayon and silk manufacturing industries were confined to the Middle Atlantic and New England States, but there has been a considerable movement southward by firms producing rayon broad woven goods. Dispersion from the cities into nonindustrial areas of the North as well as the southward movement of the industry can be traced to lower labor costs. The portion of the industry in the North which remains in the cities produces, for the most part, better grade fashion fabrics, while that in the nonindustrial areas, particularly in the South, manufactures more standardized materials.

The great majority of the wage jobs in the pottery industry in 1939 were in the Middle Atlantic, South Atlantic, and East North Central States, despite the fact that the chief raw materials occur in deposits scattered throughout the country. The relative localization of the industry is due to early establishment of certain centers within these areas, the accumulation of pools of skilled labor, and the fact that ovens, kilns, and storage facilities, once installed, cannot be readily

moved. The availability of natural gas has been an important location factor so far as the portion of the industry in the Ohio Valley is concerned, but the possibility of greater use of electricity in heating kilns makes practicable the development of new locations wherever the materials and low-cost power can be found.

In 1939, the machine tool industry was heavily concentrated in the New England and the East North Central regions with the bulk of the remainder in the Middle Atlantic States.[19] In 1929, about half of the wage earners in the industry were found in the principal cities of industrial areas, most of the remainder being about equally divided between the peripheries of industrial areas and nonindustrial communities. The attraction to the large cities is due to the need for highly skilled workmen and the opportunity of sharing the services of designers and other skilled artisans. At the same time, the products of the industry have such a high finished value that the addition of transportation cost, in the case of the firms at a somewhat greater distance from their industrial market, is not a serious disadvantage if other locational factors are favorable. However, the boundaries of the area in which the industry may best be located are determined by geographical disposition of manufactures generally.

The location of the stoves and ranges industry is greatly influenced by the location of its materials, as evidenced by the fact that somewhat less than half of the wage jobs in the industry in 1939 were in the East North Central States. The adjacent Middle Atlantic, West North Central, and East South Central areas accounted for most of the remaining wage earners. Skill is less important in some portions of the industry where the product lends itself to standardization and mass production. Thus, it is probable that the larger firms are represented in the third of the industry located in nonindustrial areas while smaller firms still seek locations in the large industrial cities and their peripheries.

In the newspaper publishing field, speedy methods of transportation and the depression have no doubt increased the relative importance of the large metropolitan dailies, but thousands of small newspaper publishing firms are still in existence in small towns throughout the country. The publication of periodicals, however, is concentrated mostly in the large cities.

Most of the paper box industry is presently located in the manufacturing belt composed of the New England, Middle Atlantic, and East North Central States. More than half of the industry in 1933 was located in the principal cities of industrial areas, reflecting a similar concentration of the manufacture of light packaged goods. The high cost of transporting empty containers and the fact that firms require little capital equipment and little space tend to keep the set-up box industry in the industrial areas. Transportation cost would, however, not be important in the case of collapsible containers, so that some firms are found in nonindustrial areas.

The bread and bakery products industry is distributed in rough correspondence to the population scatter except that commercial bakery products are less extensively used in the Southern States than in other parts of the country. Also, home-made products have a greater importance in rural communities than in the urban or industrial areas. Because of the perishability of the product, breadmaking establishments are limited in size, but horizontal combinations of independent plants as well as growth of plants are increasingly evident in the large urban centers. Thus, small bakers are more predominant in less populated areas.[20] A sample study of 46 small baking corporations (those with assets less than $250,000), indicated that in 1930 somewhat over a third of such corporations were found in the East and West North Central States.[21]

The last five industries in this group are located primarily in predominantly rural areas. They include cotton goods (somewhat different grouping of related industries than "cotton manufactures" listed in table 3), lumber and timber products, furniture, clay products, and planing mill products.

In 1939, about 75 percent of the cotton goods industry was in the Southern States, while about 20 percent was in the New England and Middle Atlantic States. The locational characteristics of the northern and southern industries are markedly dissimilar. In the North, most of the wage jobs are in the principal cities of industrial areas, peripheries of such areas, and in important industrial counties. But in the South a large majority of the wage earners are found in the predominantly rural areas and most of the remainder in industrial counties outside of the large industrial areas. The northern mills have tended to specialize in finer grade cloth while those in the South, with less skilled labor, in cheaper staple goods. The dominant

[19] A sample study of small machine-tool manufacturing corporations (those with assets under $250,000) shows that there was in 1930 a somewhat greater concentration of small firms in the Middle West (East North Central and West North Central regions) than was true of the industry as a whole in 1929. Charles L. Merwin, jr., *Financial Characteristics of American Manufacturing Corporations*, Temporary National Economic Committee, Monograph No. 15, p. 10.

[20] "As a general thing, the big bakers have concentrated their business in the larger urban centers." A. C. Hoffman, *Large-Scale Organization in the Food Industries*, Temporary National Economic Committee, Monograph No. 35, p. 48.

[21] Merwin, *loc. cit.*

incentive for the southward transfer was the wage differential which has subsequently been narrowed by legislation and unionization.

High transportation costs not only confine the lumber and timber industry to the areas where the raw material exists but they also cause the scale of operations to be determined by the density of the timber stand. Thus, a relatively large number of small producers are spread throughout the South where timber stands have been greatly depleted by past exploitation, while a growing number of large producers are evident in the Pacific Northwest where virgin forests still exist.[22]

The furniture industry exists to some extent in every region in the United States. In 1933, however, there was a much greater representation of this industry than of all manufacturing in the East North Central and South Atlantic States. On the other hand, a sample study of 61 small furniture manufacturing corporations (with assets of less than $250,000) for 1930 indicates that about one-third of the small firms, compared with less than 10 percent of the entire industry, are located in New England, a somewhat smaller percentage of small firms than the proportion of the entire industry is found in the Middle West, and a considerably lower percentage in the South.[23] Considered by types of area, about half of the wage jobs in 1933 were in industrial areas and important industrial counties, while the others were in cities outside industrial areas and predominantly rural counties. The preponderance of small firms in New England and their existence in industrial areas of the Middle West is traceable to the high quality and rapid style changes which characterize their product. Standardized lines of cheaper furniture can be manufactured on a larger scale and more advantageously outside the congested areas.[24]

Clay products (bricks, tiles, sewer pipes, etc) are necessary wherever building construction takes place. Since the raw materials are widely distributed and the finished product heavy and of low value, shipment of either over long distances is uneconomical. In 1933, about one-half of the wage earners were found in the predominantly rural communities, and about a fourth in the industrial peripheries to meet the concentrated needs of industrial areas.

The planing-mill products industry consists of the manufacture of dressed lumber, wooden doors, sashes and moldings, frames, etc., not made in connection with saw mills. This industry, like clay products, is auxiliary to building construction, but it also has the characteristics of a service trade in that the products are largely made to order. Thus, it tends to be distributed in roughly the same manner as is population throughout the country.

Group II

To some extent, the locational characteristics of the remaining industries may be seen from an inspection of their geographic distribution. Without a careful study of each industry, however, it is impossible to approach accuracy in detecting specific factors that have determined location in the past or those which are changing locational patterns today. No attempt is made here to do more than to outline locational characteristics that are readily observable.

A common feature of one group of industries is that there is little or no localization, but the reasons for their relative geographic dispersion vary. In the case of the butter and cheese industries, both the raw materials and the finished products are relatively perishable. Since the former is available to some extent in all sections of the country, the manufacturing process takes place close to the ultimate consumer in typically small establishments. With the exception of a concentration of cheese manufacturers in Wisconsin and butter manufacturers in the dairy States of Wisconsin, Minnesota, and Michigan, both industries are well dispersed. However, as in the case of bread baking, manufacturing on a relatively large scale has been made possible by the advent of new methods of production and refrigeration. In the large cities and heavily populated areas, large producers, with fewer establishments than would be the case under independent ownership, can exploit the more concentrated markets.

The geographic distribution of the concrete products industry is determined by the location of building-construction activities. The industry is close to the markets it serves, since transportation costs from a distance would be prohibitively high for its heavy, low-value products. Savings in transportation costs also pull such industries as window and door screens and weather strip, wooden boxes, lubricating greases not made in petroleum refineries, and nonalcoholic beverages, close to the consuming centers. Lumber is much less expensive to transport than many lumber products which are of greater bulk and of low value. In the case of lubricating greases, it is relatively cheaper to receive the raw materials in bulk quantities

[22] Thorp and others, *op. cit.*, p. 47.

[23] Merwin, *loc. cit.*

[24] The industry centered around High Point, N. C., started with "low-grade furniture for a cheap market" but in recent years the quality has been somewhat improved and mass production methods are employed. "Furniture manufactured in High Point is now classified as 15 percent fine grades, 70 percent medium grades, and 15 percent cheap grades." (Unpublished study of the National Resources Planning Board.)

from petroleum refineries, and distribute the finished products in small containers from a point closer to the market. Similarly, in the nonalcoholic beverages industry, the weight of the bottled products relative to their value is so great that the bottling is done at points which will maximize distribution possibilities and minimize transportation cost.[25]

The cutting and shaping of marble, granite, slate, and other stone is only one step removed from the quarrying operations which must, of necessity, take place where deposits occur. Except for a noticeable concentration of the industry in Vermont and Georgia where localized marble deposits exist, it is fairly well dispersed.

The manufacture of brooms, baskets, and willow ware, and artificial flowers requires little capital equipment and nonspecialized materials. Thus, these industries are represented by small shops all over the country.

A second group of industries, comprised of stereotyping and electrotyping (not done in printing establishments), engraving and wood and plate printing, lithographing, book-binding, and blank-book making, photo-engraving (not done in printing establishments), and signs and advertising novelties, has many of the characteristics of service trades. Their customers are, in the main, the commercial and financial establishments located in cities. The distribution of these industries is therefore in accordance with the location of cities, the sizes of which in turn determine the sizes of firms.

Machine shops and sheet-metal working firms are, also, to some extent, local service industries. Both show marked concentrations in the industrial regions of the East North Central, Middle Atlantic, and West North Central States, where the greatest demand for their services exists, but small firms are scattered throughout the country.

The first two general categories of industries were characterized by geographic dispersion. A third group is composed of industries which are almost entirely concentrated in the Middle Atlantic and New England States, because (1) the products of the industry are highly specialized and must be manufactured close to the wholesale markets and production center in New York City, or (2) the industry serves another industry localized in that area. The former subgroup consists of fur goods; leather goods (not elsewhere classified); pocketbooks, purses, and card cases; leather gloves and mittens; toys, games, and playground equipment; men's furnishing goods; and umbrellas, parasols, and canes. The second subgroup contains embroideries and trimmings not made in textile mills; buttons; furs, dressed and dyed.

The remainder of the industries listed in tables 3 and 4 have heterogeneous locational patterns. While the influence of raw-material location or specialized markets is apparent in some cases, it would be hazardous to try to interpret the particular patterns without more information.

Factors Favoring Small Firms

From the kinds of industries in which small firms seem to predominate and the locational characteristics of such industries, the factors responsible for the efficiency of small firms in particular areas may be deduced. Chief among these are functional specialization and locational influences.

Functional Specialization[26]

Among the elements which have provided the impetus toward increased firm size are the basic economies obtainable from large-scale operation. These economies which have arisen out of the growth of functional specialization may be generally categorized as follows: (1) *technical economies* derived from use of large-unit machinery, continuous-flow operations, functional specialization among plants, standardization of products, and utilization of waste materials; (2) *managerial or administrative economies* arising from better research departments, better industrial planning, functional specialization of management tasks, and the application of expert talent to those tasks; (3) *marketing economies* represented by saving in cross-hauling, more efficient use of sales organizations and advertising media, and the ability to capitalize upon the trade name or reputation of a particular product by using the same sales organization to distribute a variety of products; (4) *purchasing economies* possible through buying in large quantities; and (5) *financial economies* reflected in lower interest rates on borrowing.

While these economies are a function of size, indefinite expansion in firm size is impossible since the rate of increase in possible economies diminishes after certain proportions are reached, whereas offsetting costs, also a function of the magnitude of operations, increase rapidly after the scale of operations exceeds a certain level. The diseconomies are largely the result of the declining efficiency of management as the need for coordination increases. At some point, therefore, the

[25] For example, Coca-Cola syrup is manufactured in eight centrally located plants scattered throughout the country. It is shipped to jobbers in local communities, who are usually independent operators with exclusive distribution privileges for a specified territory, to be processed into the finished product and to be bottled for distribution.

[26] Much of this discussion is based on E. A. G. Robinson, *The Structure of Competitive Industry*, Nisbet and Cambridge Univ. Press, 1931.

diseconomies of increased size balance the economies and a theoretical optimum scale is reached for any particular firm. Expansion beyond this point must proceed in the face of increasing unit costs.

To put it in another way, a limitation on the size of firms arises out of the fact that the scale of operations necessary in order to maximize one set of economies is different from that dictated by another. In order to achieve an optimum firm size, some reconciliation of the various optima is necessary. Of course, if the optimum scale of operations as determined by each criterion is uniformly high, the optimum firm size will be large. Also, if the size of firm most advantageous from an administrative point of view is very large, while the technical optimum is low, the number of productive units can be increased until the administrative maximum is reached. This is possible because no diseconomies result from the multiplication of technical units as such (either machinery within a plant or plants within a firm).

However, if the technical optimum is larger than the administrative optimum, the latter cannot be exceeded except at increased cost so that the size of the productive unit is limited to the lower optimum, all other things being equal. Functionally linked firms (e. g., firms engaged in meat packing, leather tanning and finishing, shoe manufacturing, and other leather goods) might more commonly amalgamate were it not for prohibitive managerial diseconomies.

If the technical optimum of the key processes in the manufacture of a complex product is lower than the optima of less important processes, vertical integration of such processes is not likely to occur. In automobile manufacture, for example, some of the essential parts are frequently supplied by outside firms. The production of clocks and other electrical fixtures can usually be accomplished more efficiently at higher levels of output than would be consumed by a single automobile firm.[27] Thus, a number of relatively small specialized firms may exist instead of a superfirm manufacturing everything that goes into a complex product.

In other cases, the management optimum may be so low that neither vertical integration of related production processes nor horizontal combination of specialized production units is possible. This is particularly true of industries in which the style factor is important. The efficiency of any group of small firms, however, will be enhanced to the degree that functional specialization exists in related industries, in marketing organizations, or in service enterprises. Thus, small dairy-products firms, by virtue of a cooperative marketing organization, or small garment manufacturers, through the vast facilities of the New York "production center,"[28] can get the benefit of external economies which large firms must achieve within their own organizations.

An adequate discussion of the checks and balances which determine firm size cannot be given here nor would it be directly relevant. It is sufficient for our purposes to suggest that, while functional specilaization results in economies which make large-scale operations possible, it also generates diseconomies that may be avoided only by keeping firm size small. Other things being equal, the diseconomies of large-scale operation are likely to make optimum firm size small in industries where the products are for a small specialized group of consumers, are subject to frequent and drastic changes in style, or require craftsmanship rather than standardization. Conversely, highly standardized products not likely to vary greatly in design and complex products which involve assembling operations are most susceptible to large-scale operations.

Influence of Location on Size of Firm

Since manufacturing activity is the adaptation of raw materials or the products of previous processes for the next stage of processing or the final consumer, the geographic distribution of such manufacturing is determined by a host of cost considerations which have to do with the processing of materials and the marketing of manufactured goods. What these factors are and their relative importance in determining location have already been described at some length in preceding chapters. However, it should be indicated here how they also tend to limit the size of plants and hence, in some cases, make possible the existence of small firms.

Among the prime factors affecting location are transportation costs which are incurred in bringing materials to the point of processing or in transporting the finished product to the market. Where transportation costs are of such importance as to exercise a dominant influence on location, they invariably have an effect upon plant size at any particular site. This is true because transportation costs increase as materials are sought in more remote areas or as market boundaries are extended. Whether a plant is "raw material oriented" or "market oriented," the theoretical

[27] The Federal Trade Commission makes the following comment: "Chrysler, which is considerably smaller and far less integrated than either of the two larger companies, has made better profit margins on its Plymouths than Ford or General Motors have made on their comparable automobiles (Fords and Chevrolets) during most of the years since the depression. Chrysler, furthermore, had a higher rate of return on its invested capital than Ford or General Motors." *Relative Efficiency of Large, Medium-Sized, and Small Business*, Temporary National Economic Committee, Monograph No. 13, 1941, p. 91.

[28] See chapter 14 for discussion of the relation of sizes of plants and firms to production centers.

optimum scale of operations at a fixed location is surpassed when transportation costs increase the total cost for the marginal unit of product so that the latter exceeds the revenue received from the marginal unit. While transportation costs increase with the area of a territory, the rate of increase is determined by the density of materials or markets. Thus, as shown in the preceding section, large firms owning large plants can exist in areas where materials or markets are heavily concentrated. But in areas in which materials or markets are sparsely distributed, the economies of large-scale operation cannot be realized so that the optimum size of plant is relatively small. While this does not necessarily mean that the firm must also be small, it does indicate that in such communities small firms can operate efficiently.

The effect of increases in transportation cost upon ths scale of operations may be offset by other locational factors. The existence of cheap fuel and power, a cheap and plentiful labor supply, or lower taxes in isolated communities can lower the total cost sufficiently so that a firm can overcome greater distance diseconomies without loss. In industrial areas, external economies arising from the availability of numerous services may diminish the effect of transportation costs.

Factors Which Weaken Small Firms

The inapplicability of mass-production techniques in many industries, the relative scarcity of raw materials and markets in some areas, as well as the demand for a wide variety of manufactured goods, still provide many opportunities for firms to be both small and efficient. Nevertheless, a disproportionate number of small firms find profitable operation difficult or impossible. Without minimizing the extent to which technological innovations or new conditions in industry constantly cause the competitive displacement of small units by larger firms, it is of course possible that the major explanations for the precarious economic status of many small firms lie outside the question of relative efficiency. Certainly the factors discussed briefly below are taking a heavy toll of small firms in many industries and geographic areas of the country, regardless of the operating efficiency of such firms.

"Cutthroat" Competition

The economically efficient small firm may be driven out of business if a large firm, protected by large financial resources, engages in "cutthroat" methods to rid itself of competition. Such practices have been far from uncommon in the industrial history of the country. They may be resorted to by a large firm precisely because smaller units are at least equally efficient and, therefore, cannot be eliminated by "ordinary" rivalry in the market.

The explanation for the growth of firms beyond the level of optimum operating efficiency is a familiar one to students of business. "Bigness" is frequently due not to gradual expansion of technical units within a firm, but to mergers and consolidations of independent firms without greatly altering the operating conditions within such firms. The motivation for such growth lies outside considerations of efficiency. There may be, in fact, an actual loss of productive efficiency not entirely offset by financial or managerial economies of size. The desire on the part of some individuals to realize promotional and underwriting profits or the desire of corporate groups to insure profits through price stabilization may constitute the chief incentives.[29] Where the latter is the dominant cause for the creation of a large firm, it is obvious that no mere claim to efficiency can safeguard the existence of a small firm which insists upon independence in the formulation of price and production policies.

Inadequate Sources of Capital and Credit[30]

The problem of inadequate capital and credit resources was a peacetime phenomenon, but since the beginning of the armament program it has been greatly accentuated in some cases and alleviated in others, depending on whether or not the small firm has succeeded in obtaining war orders or has been assured a continuing share in the production of civilian goods.

The "ordinary" peacetime capital and credit difficulties of small firms were due to institutional changes in the economy. The growth of large corporations has been accompanied by a parallel growth of investment banking and the intricate organization of the financial market through which a major portion of long-term investment funds are canalized. These media have been increasingly adapted to the needs of large corporate units and have become correspondingly less suited to meet the long-term capital requirements of small enterprises.

The first obstacle to the utilization of the investment banking machinery is the high flotation costs for small issues. Fees required by underwriters and other distributors of securities; expenses in connection with the investigation and preparation of an issue; and, to some extent, registration fees for qualification under the Securities Act of 1933 are fixed charges which loom proportionately larger as the size of the issue decreases. A second and perhaps more fundamental reason for

[29] See Temporary National Economic Committee, Monograph No. 13, p. 95; statement of Myron W. Watkins, *ibid.*, pp. 133–139.

[30] Most of this discussion is taken from John H. Cover and others, *The Problems of Small Business*, Temporary National Economic Committee, Monograph No. 17.

the failure of small enterprises to utilize the medium of investment banking in obtaining capital is the increased liquidity preference on the part of the individual and institutional investors which has, in turn, prevented investment bankers from underwriting small issues having less marketability and involving greater risk than those of large-established corporations.

The most important source of long-term capital funds for small enterprises, particularly for the unincorporated firms, has been wealthly individuals. But ready access to this source has steadily diminished as individuals have tended to institutionalize personal savings as well as to diversify investment portfolios among listed securities of known quality and marketability. Only a negligible portion of the savings which go into life insurance companies, savings banks, building and loan associations, etc., is reinvested in small business undertakings. Moreover, despite low yields, the increased volume of government tax-exempt investments has succeeded in diverting a large portion of what was formerly available as venture capital.

Whatever degree of success small enterprises may have had in financing expansion internally through accumulating surpluses was considerably diminished by the vicissitudes of the depression period and by the growth of the tendency to extend lines of credit to customers. In both cases, internal sources were taxed so heavily for working capital that provision for long-term needs was out of the question.

As the avenues to long-term capital narrowed, small enterprises were forced to rely more extensively on short-term credit. In the predepression period, short-term credit requirements were in the main supplied by commercial banks, but subsequently bank credit became quite costly for small enterprises. During the upswing phase of the cycle, bank loans of varying maturities were made freely, and more often than not, renewed at the firm's request. When business activity began to drop rapidly in 1929, banks attempted to regain liquidity by demanding payment of both principal and interest on outstanding loans and restricting further lending operations. Small enterprises were, for the most part, unable to do much more than to continue interest payments and to retire small portions of the principal on such loans.

The result was that, while banking policy grew increasingly more conservative during the thirties, the "credit-worthiness" of small firms declined markedly by virtue of lower current ratios and decreases in the ratio of owners' equities to creditors' claims. Furthermore, the anxiety on the part of the banks to minimize risks and maintain liquidity increased the administrative cost of making loans. Thus, the smaller the loan, the smaller the margin of profit, and the less likely it was to receive favorable attention.

Another post-depression development which contributed toward credit stringency was the changed character of the banking system. Many local banks, integral parts of their business communities, were closed down and often replaced by branch banks of larger institutions. Added to the fact that banking policy generally became less liberal with respect to small enterprises, the incursion of branch banks and professionalized management succeeded in further restricting bank credit to local firms. Even for short-term credit, small enterprises were obliged to resort to extra banking sources, such as machinery and equipment manufacturers, factors, and various types of installment and business finance companies, which exacted high tribute in return for assuming risks that banks could not or would not accept. These intermediate financing agencies grew despite the low level of industrial production during most of the past decade. In this period the volume of factoring operations and the business of sales finance companies were greatly increased.[31]

In 1934, through amendments to the Reconstruction Finance Corporation Act and the Federal Reserve Act, the Federal Government supplemented existing loan channels open to small firms.[32] Both agencies were initially empowered to extend working capital loans with maturities not in excess of 5 years to established businesses, provided that the applicants could not secure credit at banks. In 1938 a further change was made in the RFC Act permitting longer-term capital loans. Analyses of loans made by these agencies prior to 1942 indicate that the dollar volume of loans of $50,000 or less were probably less than one-fifth of the total amounts authorized.[33]

After the beginning of the armament program, the capital and credit facilities of both private and governmental financial institutions became more accessible to small producers who were fortunate enough to obtain war orders. However, the inability to finance the acquisition of necessary equipment, materials, etc., prevented most small firms from obtaining contracts. An attempt to alleviate this situation was made in March 1942, when an Executive order authorized the War and Navy Departments and the Maritime Commission to participate in or guarantee loans for war production purposes.[34] In June 1942, the Federal Government, by Congressional action, added further to the powers of

[31] Woosley, John B., "The Capital Problem of Small and Medium Sized Businesses," *The Southern Economic Journal*, April 1941, p. 468. See also Hearings before the Temporary National Economic Committee, 76th Cong., 1st sess., part 9, pp. 3993 and ff.

[32] Public, No. 417, 73d Cong.

[33] Based on data compiled by the Reconstruction Finance Corporation and the Federal Reserve Board.

[34] Executive Order No. 9112, March 26, 1942.

Federal agencies to assist in the financing of small firms.[35] First the Small War Plants Corporation with capital of $150,000,000 was created to make loans through the Federal Reserve Banks directly to small concerns engaged either in war or "essential civilian" production. No statutory limitation on terms or maturities was placed on these loans. Second, the previous limitations on the amount of loans to any one person by national banks was removed in the case of loans secured by guarantees by Federal Reserve Banks or Federal Government agencies. Third, the War and Navy Departments were authorized to participate in or guarantee loans made by the Reconstruction Finance Corporation "for any purpose deemed by the Corporation to be advantageous to the national defense."

During the four-month period after the issuance of the March Executive order, 800 bank loans totaling $450,000,000 were made, of which 60 percent of the number of loans was for amounts less than $100,000. No published information is available, however, on the share of loans of this size in the aggregate amount loaned.[36]

Lack of Research Facilities

Small enterprises with limited financial resources are seldom able to establish adequate research facilities. Yet the fact that the existence of many small firms depends on their ability to provide specialized or unique products makes experimentation and research doubly important. It appears that the more firmly established small concerns are able to be self-sufficient in adjusting processes or changing products in order to meet the demands of large industrial units, discriminating customers, or selected markets, but most small companies must turn to outside sources for research on long-range developments in the technical sciences important to their field of activity.[37] Moreover, unless wider access to the results of research into new products and new methods is given to potential small producers, the importance of small firms as pioneers in new industries will be diminished.

Special Problems Under War Economy

The shift to a war economy has added to the hardships of small firms. Those owning plant and equipment which might be utilized in war production have experienced difficulties in obtaining orders. Others which have been primarily engaged in the production of consumers' goods and therefore do not possess facilities adapted to military production have found it difficult to convert such facilities. Moreover, an increasing number of small firms which have no alternative but to continue producing for civilian consumption will be eliminated as materials are diverted to war production.

The problem of allocating any significant portion of war orders to small firms originated in the fact that only the large integrated producers could assume responsibility for such large and complex items as tanks, planes, ships, or heavy artillery pieces. Even in the case of other items, where the unit size of the article required was smaller and it was possible to produce it on a small scale, large manufacturers were favored since they could make deliveries in large quantities. Under such circumstances, the share of small firms in war orders depended on (1) the willingness of prime contractors to sublet portions of their work, and (2) the willingness of Government procurement agencies to break up the size of prime contracts and thus permit smaller firms, or "pools" of firms, to submit bids.

There have been major obstacles impeding the diversion of war contracts to small producers through these means. Costs of supervision and inspection increase for the prime contractor as the volume of subcontracts given to inexperienced firms increases. Transportation costs rise as the distance between the assembly point and the points of production is extended. Such costs either reduce profits for the prime contractor or result in increased delivered cost to the Government. Piecemeal allocation of orders by the Government necessitates the direct incurrence of these costs as well as the responsibility for assembly operations.

The plentitude of materials and labor during the first stages of the armament program caused the construction of new plant capacity by large producers to be favored over any real attempt to utilize existing capacity owned by small firms. However, both materials and labor have become sufficiently scarce to prohibit the construction of new capacity, except in absolutely essential fields. Since the level of military needs will continue to increase, an increase of output must be accompanied by greater dependence on small firms and high-cost producers.

Policy Considerations

The observations which may be made on the basis of this study are twofold in character: (1) the great majority of existing small manufacturing firms, except those which serve small consumer markets and those which exploit localized raw material resources, are located near the centers of industrial concentration, and (2) the most urgent problems of small firms are not those which arise because of poor location.

It is not surprising to find that small firms have found it advantageous to be in areas of intense manufacturing

[35] Public, No. 603, 77th Congress.
[36] *Journal of Commerce*, August 8, 1942.
[37] National Resources Planning Board, *Research—A National Resource, II. Industrial Research*, December 1940, pp. 78–84.

activity. Many of them are intermediaries in the production process, using semiprocessed materials and serving industrial markets. Others are in "residentiary" or service industries which supply the needs of larger producers. In both of these cases, such factors as transportation costs and the access to pools of skilled labor are of major importance in determining location. A large group of small firms are located in the heart of the industrial Northeast, i. e., the area in and contiguous to New York City. These firms, engaged in the production of highly specialized consumer goods, derive substantial benefits from being close to a production center where functional specialization has resulted in a profusion of related and service industries.

In fact, far from showing that small firms flourish in nonindustrial areas or in sparsely populated communities, the survey indicates that the reverse is true. While some of the industries, in which smallness of firm is apparently not a handicap, are represented in nonindustrial areas, in such areas firms tend to be large rather than small. This can be attributed to the fact that firms located outside industrial areas find it difficult to manufacture specialized or style goods, and in the production of standardized goods, large-scale units are more efficient. Under these circumstances, major changes in the location of small firms cannot economically be effected without a general shift in the location of manufacturing. That either decentralization or diversification once accomplished will increase the opportunities for small firms is to be doubted. Moreover, it must be remembered that most manufacturing which can profitably be undertaken by small firms is as well suited for branch plant operation by large firms.

Even if locational shifts can and do take place, it is obvious that they will not necessarily open up capital and credit channels to small firms or result in a net increase of war orders to small manufacturers. These and other problems discussed above that are most onerous for small firms must be solved by public action through means other than locational policy.

CHAPTER 18. PRICE POLICIES

By Gardner Ackley*

Among the factors which influence industrial location, one of the least tangible is the existence of price policies. A price policy is a rule of business behavior which may have been recently and consciously erected to meet a specific problem, or it may have gradually evolved, gaining the almost unconscious adherence given an inherited institution. It may be the policy of a single firm, or may have elements common to all firms in an industry. It may relate directly to the price, or only to one element of it, e. g., discounts: or it may relate only indirectly to the price, e. g., a policy regarding quality of the product.

Under the theoretical "perfect competition" which simplifies much economic analysis, such price policies do not and cannot have any existence. In this hypothetical state, the seller supplies such a small part of the total output of a standard commodity that he can have no independent influence on its price—hence no price policy. He can only accept the existing or expected market price and produce until his last unit adds an amount to his total cost equal to the market price. The price itself is simply a datum so far as he is concerned. Except for Federal intervention, such conditions are typical of agriculture and many extractive industries.

The mere existence of a "price policy" implies that a seller can in practice influence the price at which his product is sold. It follows, therefore, that "perfect competition" in that industry does not exist. As a matter of fact, the whole trend of modern economic analysis gives emphasis to the almost universal imperfections of competition; so that business men today, in defending themselves from actual or potential action under antitrust legislation, no longer feel required to argue that theirs is an industry of perfect competition.

No one will contend that—except in rare cases—pricing policies are a dominant locational factor. Likewise, it is not suggested that the conscious object of price policies is often a locational one. Such policies, nevertheless, affect competitive relations among producers, price levels, product structures, forms of retail and wholesale distribution, existence of branch plants, the degree of vertical or horizontal integration, and many other important aspects of the industrial structure; and so exert an indirect effect upon location.

It is true that the geographical pricing arrangements made at any particular time reflect the existing geographical scatter of sellers, and exert little or no force in the direction of relocation. But with the growth of an industry, new sellers enter the field, who usually accept the existing pricing policy, and hence must locate in accordance with its pattern of profitability. Thus a price policy may over a long period give a cumulative distribution of capacity quite different from that which another pricing system would have yielded. It must likewise be recalled that even in the absence of new sellers or of relocations by existing sellers, two pricing policies might have substantially different locational effects simply by giving substantially different distributions of total sales among the various existing producing locations.

The types of pricing policies most frequently exerting a locational influence are those which determine relative delivered prices at different geographical locations. However, other elements of pricing and selling policy such as differentiation through branding, advertising, special services, or quality differentials, and methods of delivery and distribution, may be related to the geographical distribution of sales or sellers.

Types of Geographical Pricing Systems

The following classification embraces the more important policies relating to relative delivered prices at various locations.

1. *Delivered prices varying according to transport costs.*

a. F. o. b. pricing. The delivered price charged by any seller equals a uniform price at the seller's location plus freight from seller to destination. It makes little difference whether freight is paid by buyer to the carrier or paid by seller to the carrier and then included in bill to buyer; we shall call either case "f. o. b. pricing," although this term refers strictly only to the first. As an example of f. o. b. pricing, canned tomatoes are almost always priced f. o. b. the cannery.

b. Basing-point pricing (quasi-f. o. b.).

(1) Single basing-point system. The delivered price paid by any buyer equals a uniform base price at some point designated as the (freight) basing point, plus freight from basing point to destination, regardless of source, route, or mode of shipment. For example, during most of the period from 1900 to 1924, all steel, wherever produced or sold, was priced f. o. b. Pittsburgh.

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(2) Multiple basing-point system. The delivered price paid by any buyer equals the lowest possible sum of price at any basing point plus freight from that basing point to destination, regardless of source, route, or mode of shipment.

(*a*) Not all sellers located at basing points. For example, in February 1939, hot rolled steel sheets were priced f. o. b. Pittsburgh, Cleveland, Youngstown, Middletown, Buffalo, Birmingham, Chicago, Sparrows Point, Granite City, and certain Pacific ports, with the delivered price at any destination equal to the lowest sum of base price plus freight. Yet, as of that date, 42.3 percent of the production capacity for sheets was at points more than 25 miles from a basing point.

(*b*) All sellers located at basing points (sometimes called "mill-base system," or "systematic freight equalization"). For example, in the chlorine industry, all sellers are in effect basing points.[1]

2. *Delivered prices uniform within areas.*

a. Nationally uniform delivered prices. For example, ingot aluminum is sold anywhere in the United States at the same delivered price. It makes little difference whether the seller pays or "absorbs" the freight, or whether the buyer pays it and subtracts it from the list price. The same comment applies to zone systems.

b. Delivered prices uniform within geographical zones.

(1) Possibilities as to zone patterns.

(*a*) Each seller has his own pattern of zones. For example, each producer of electric refrigerators has an individual zone system on the retail level.

(*b*) All sellers use the same zone division.

i. All sellers' prices the same in each zone. For example, all sellers of synthetic methanol use the same zone pattern and quote the same zone prices.

ii. Sellers charge different prices in the same zone. For example, all producers of snuff employ the same five price zones, yet their prices vary among zones in different fashion.

(2) Possibilities as to relative prices among zones.

(*a*) Zone prices related roughly according to freight rates from some point or points (corresponding to f. o. b. or basing-point systems). For example, the three price zones for most business furniture probably approximate the delivery costs on the product of those producers who do business on a national scale, and who are all located in the East.

(*b*) Variation of prices as between zones not related to any actual freight charges (corresponding to 3, below). For example, the fact that delivered prices of paper board are at some times higher in the central zone than in the eastern, and sometimes lower, shows that the differentials are unrelated to freight charges.

3. *Delivered prices vary unsystematically.*

a. A stable pattern of variation, used by all sellers.

b. A fluctuating, noncooperative pattern of delivered prices. (Includes departures from any of the above systems.)

4. *Various combinations of the above patterns.* For example, range boilers are sold on a uniform delivered price east of the Mississippi, on a basing point system in the West.

It should be noted that in all cases, except uniform f. o. b. pricing, "freight absorption" exists; that is, a seller may receive a higher "mill-net" (net receipts after payment of freight) from some sales than from others.[2] There are other definitions of "freight absorption," but this is the simplest. The difference between the mill-net on any sale and the highest mill-net received from any sale of the same product is the amount of freight absorption (ignoring special discounts or unsystematic price concessions).

Of these several types of geographical pricing policies, one—f. o. b. pricing—has received the special blessing of certain economists and Government officials who designate it the "normal" method of pricing and all others abnormal and somehow suspect.[3] There seem to be three possible reasons for this belief. In the first place, f. o. b. pricing is the pattern which would exist if there were perfect competition (i. e., so many sellers of an identical commodity that no one of them could influence the price) at each producing point or region. In other words, although f. o. b. pricing may represent a deliberate price policy, it is also the price pattern which must exist in the industry in which there can be no price policy. And, indeed, f. o. b. pricing does exist in our most "competitive" industries: cotton and woolen yarns, gray goods and finished cloth, leather, boots and shoes, most apparel, most canned and dried food products, especially unbranded and unadvertised varieties. Almost all agricultural products fall in this category in the sense that the farm price

[1] The only difference between f. o. b. pricing and a basing-point system in which all sellers' locations are designated as basing points is that under f. o. b. selling no seller sells to any point for less than his mill price plus freight. Under a mill-base system, a seller sells to points for which his base price plus freight is higher than the base price plus freight of another seller; but he charges a delivered price equal to that of the second seller. That is, he "absorbs freight" to reach such point.

[2] With the exception of a seller located at the basing point under a single basing-point system.

[3] It likewise receives the tacit blessing of most of those discussing locational problems, who generally assume that actual transportation costs on materials and products are always directly reflected in relative delivered prices.

equals the price at some important market less transportation, so that purchasers at other markets must pay that particular producer his base price so determined plus freight to their own stations. In the second place, it can be argued that the f. o. b. price is nondiscriminatory—any seller quotes the same mill price to each buyer. No customer helps pay for the freight charges incurred on account of some other buyer. It is said that from the legal standpoint, however (Clayton, Robinson-Patman Acts), the uniform delivered price is equally nondiscriminatory, and most of the other delivered pricing systems can be defended on the ground that any geographical discrimination is made "in good faith to meet competition." The third justification advanced for f. o. b. pricing (and the important one from the locational point of view) is that it minimizes total costs of production plus transportation. Under the f. o. b. system, relative delivered prices represent relative delivered costs; and hence maximization of profits, both by the selling industry and by its customers, means minimization of total costs, at least so far as decisions regarding plant locations, and where to buy or sell are concerned.

A careful analysis of this argument will show that it rests upon the premise that each unit produced by any one seller has the same costs as any other unit currently produced. It is frequently argued in rebuttal that this premise is based merely upon the accounting practice of allocating overhead costs equally among all units produced. Especially where different pricing policies give different total sales, it may be appropriate to allot the overhead costs unequally among the units produced and sold.

We cannot turn directly to a consideration of the desirable or undesirable locational influence of various pricing patterns, for in order to understand their locational effects we must first understand their causes—why sellers choose to use them. The following sections attempt to describe more fully the patterns listed above and their causes.

Factors in the Choice of Price Policies

The pricing policy of a seller or an industry is determined with reference to either or both of two broad types of considerations: (*a*) the direct effect of the delivered prices upon consumers of the products, and (*b*) competitive relationships among sellers.

The relation of consumer demand to the geographical pattern of delivered prices (disregarding competitive or cooperative relations among sellers) appears as the sole determinant of pricing policy only in the case of absolute monopolist, who may reconsider the conflicting elements in this demand in any way that he see fit. Yet the geographical pattern of demand undoubtedly affects pricing policies of sellers governed by all degrees of competitive relationships, although the effect may be obscured except in the case of the absolute monopolist. The effect of consumer demand upon the pricing policy of a monopolist is examined briefly in Appendix A to this chapter. The remaining discussion of factors in the choice of price policies will deal only with competitive relations among sellers.

Potential Competition

Competition which is only potential can be made to remain nothing more than potential by a particular geographical pricing policy. If a rival exists and cannot be eliminated, his presence affects a seller's price policy in a way quite different from that of a potential competitor. Of course, any seller might have both actual and potential competitors, with a price policy designed to affect both. Potential competition from small, local producers might be possible whenever a large seller's delivered price rises above a certain figure. This fact would encourage the use of a uniform delivered price, to prevent the development of small producers at the edges of the market, where delivered prices would be highest under an f. o. b. pricing system. It is likely, for example, that a uniform delivered price for electric current makes the sales areas from central stations larger than if higher delivery costs (and current losses) for longer distances were reflected in higher rates, which might make individual power generation by outlying industrial users more profitable.

If there are certain localities where competition would be most likely to develop, delivered prices in those areas may be kept very low, with higher delivered prices in the rest of the market, perhaps higher by the amount of the freight from such potentially low-cost centers—i. e., the locations of potential competitors are made basing points. In a sense this is what the naming of many nonproducing ocean ports as basing points for steel and cement seems to do—it undercuts the competition of the imported product. Or a zone pricing pattern may be constructed to eliminate potential rivals. The well-known geographical discrimination by the Standard Oil trust in the eighties is an example of the effect of potential competitors, as well as an attempt to eliminate actual competitors, upon the pattern of delivered prices.

In case there are extensive economies of large-scale production, discrimination to put or keep other smaller sellers out of the field might lower average costs of production and might allow a lower average level of delivered prices than under f. o. b. pricing, and hence a net consumer gain; though the elimination of com-

petition would (normally) encourage a higher average level—the lower prices to some buyers being more than offset by higher prices to others.

Differentiated Products

The existence of competing sellers, and their effect upon a seller's price policy, can best be introduced by a consideration of "product differentiation." Here each seller in a group has an individual product, similar to those of other sellers, yet not identical therewith. The test of whether the products are identical ("standardized") or differentiated obviously lies in consumers' reactions—whether or not different prices can be maintained at the same time and place with each producer having some sales. The more differentiated a seller's product is, the more independent becomes his price from competitive prices of rivalling products.

It is important to contrast the geographical markets for standardized and differentiated products, when the sellers are separated from one another. At any point in the market for a standardized product, all sellers must quote the same delivered price, if any except the seller with the lowest delivered price is to sell at that point. If the sellers do not quote delivered prices which vary according to the same geographical pattern, each seller will have an exclusive market area in those places where his delivered price is lower than that of other sellers, a market area which can be extended only by lowering his delivered prices relative to those of other sellers. With a differentiated product, delivered prices can be unequal and all sellers still share the market; hence whatever the pricing system, the sales areas will overlap rather than be exclusive. A seller of a differentiated product, then, might have a national market regardless of the location or prices of his rivals and regardless of his own geographical price policy. Even though his delivered prices might be higher in outlying sections than the prices of sellers located nearer to such regions, he could still make some sales in these areas. It is obvious, therefore, that his geographical pricing policy is less influenced by competitive relations with his rivals than is the pricing policy of the seller of a standardized product.

If a product is one relatively heavy and expensive to transport, f. o. b. selling would appear to be the most likely policy—the advantages gained by another policy being apparently insufficient to offset the cost of heavy freight absorptions. For example, the heavy differentiated products—household furniture, automobiles, agricultural implements, milling, grinding, and screw machinery, refrigerators, stoves, and washing machines—are usually sold on an f. o. b. basis (the last three, f. o. b. on the wholesale level only).[4]

Likewise, in certain cases where freight is insignificant and the product thoroughly differentiated, f. o. b. selling seems the prevalent mode—e. g. shoes, apparel.[5] Thus in the one case where freight is very important and in the other where it is insignificant, f. o. b. pricing is followed, in the first case because it would be too costly, in the second because there is no motive to do otherwise.

In cases where the freight element is unimportant, but where there is some motive for maintaining absolute price uniformity—as an aid to maintaining standard retail prices, for use in national advertising, or because of a customary or strategic wholesale or retail price—a uniform delivered price is the usual practice, as in tobacco products, most patented drugs, toiletries, and cosmetics. Refrigerators, ranges, and washing machines are fairly heavy, yet an attempt is made to control and standardize retail prices. Consequently, although prices to jobbers are on an f. o. b. basis, prices to dealers and to final consumers are uniform within zones, illustrating a combination of two forces at work.

An additional reason may be suggested for the frequent use of the uniform delivered price by sellers of differentiated goods. It seems likely that differentiation of one seller's product from that of other sellers usually confers upon him a substantial degree of price independence only when his price is not too distant from the price of his rivals. Minor price differences are largely ignored by buyers who prefer his product; but once the price becomes sufficiently above that of similar products, the buyers begin to desert in large numbers. (Likewise if his price is a small amount below the price of others, he gains little; a larger difference, whether the result of his actions or his rivals', brings him a relatively larger gain.)[6] Applying this concept of demand to the geographical market, we get the suggestion that a seller who wishes to sell in a national market establishes a nationally uniform price in order to prevent his price in the outer regions from being too far above the prices of local sellers in those regions. There is no need to meet their prices, yet they cannot be too far exceeded.

A special case is that in which some sellers in an industry of which the product has previously been standardized attempt to split off private chips from the market by supplying a new variety of the product

[4] *Cf.* Saul Nelson and Walter G. Keim, *Price Behavior and Business Policy*, Monograph No. 1, Temporary National Economic Committee, 1940, pp. 315–16, 330–1, 335, 336–7.

[5] *Ibid.*, pp. 300–4.

[6] In technical terms, the demand curve at any point in the market is S shaped: Convex (upward) at prices above rivals' prices, concave (upward) at prices below those of rivals.

(through packaging, branding, advertising, improved quality, etc.), the other sellers continuing to supply the original standardized product. This is likely to be part of the attempt of such a seller to expand from a local to a national market. The seller attempting this is likely to shift from f. o. b. selling to a uniform delivered price, so that his price in no part of the country is too far above the prices of the local producers. This appears in cases where the nationally advertised brands in each field are sold on the uniform delivered price basis, while the unadvertised or unbranded products are sold f. o. b., and consequently have more localized markets: many standard drug items, vegetable shortening, coffee, crackers, cocoa, tea, vinegar, molasses, condensed milk, canned soup, canned corn and peas. In the case of rice, processed cheese, and paints the unbranded product is sold f. o. b., the advertised brands on a 2- to 4-zone basis.[7]

There is another explanation for the uniform delivered price for the branded varieties, with f. o. b. pricing for unadvertised kinds, which does not rest upon the presumed demand relationship described above. When a company expands to a national market, it frequently also takes over the function of wholesaling, distributing the product directly to retailers, often in its own trucks. In the grocery and drug fields, there are so many separate retail outlets that it becomes almost impossible to allocate transport costs to individual orders; a uniform delivered or zone delivered price is easier.

Uniform delivered prices, which may or may not be identical for all of the sellers of related products, are thus frequently used in situations involving product differentiation, even though competition between such sellers does not compel any exact meetings of rivals' prices.

Standardized Products

Geographical pricing policies for sellers of standardized products can be divided into two broad classes: (*a*) Systems in which each seller has an individual price pattern—at some points his delivered prices are lower than the delivered prices of other sellers except those in his own city or with the same freight rate adjustment—and he has an exclusive market area, with a rather sharp borderline at the points where some other seller's delivered price becomes lower; and (*b*) systems in which several sellers quote in accordance with a common price pattern, having identical delivered prices, hence sharing a common sales area. We may call the former "exclusive area" and the latter "equalization" schemes.

[7] Nelson and Keim, *op. cit.*, pp. 298–300, 314, 323–4.

Exclusive Area Systems

Exclusive sales areas result from the f. o. b. pricing of any standardized product. This pricing basis is characteristic of certain standardized products, most of which are thought to be rather highly competitive although not subject to violent fluctuations of demand and hence not exposed to long periods of great overcapacity. They are usually products of industries in which out-of-pocket costs constitute a larger than usual fraction of total costs.[8] Examples of such products are woolen and cotton yarns, most grey goods and cloth, leather, lard, canned and dried fruits, canned tomatoes, bulk cheese, and the unbranded varieties of the items listed above, the branded varieties of which are sold on a uniform or zone delivered basis.

Exclusive market areas for standardized products might also occur under other pricing patterns than f. o. b. Sellers might charge delivered prices just less than a rival's out-of-pocket costs plus freight. In this way delivered prices would be lowest at the market area borderlines, and highest at the centers of the market areas. Or sellers might discriminate in any profitable way within their own areas, just so that no delivered prices were high enough to allow the entrance of rivals. And, of course, under any pricing pattern, voluntary division of the market might occur, with sellers refusing to sell across certain definitely determined market area borderlines. Because our information as to selling practices usually refers only to the more formal method of price quotation, we cannot tell how frequent is this refusal to engage in the mutual invasion of sales territory under other than of f. o. b. pricing.

While f. o. b. selling typically means a distinct sales area for each seller, or each group of sellers at a single point, there is one case in which f. o. b. selling does not stand in the way of a national market for all sellers of a standardized product. This possibility occurs in industries all of whose producers are bunched in a fairly small area. In this case the railroads are likely to equalize freight rates on the product from all points in the area to all of the rest of the country, thus making it possible for all sellers to share the national market. Examples of industries concentrated in small areas, pricing on an f. o. b. basis, are turpentine, concentrated in Georgia, Florida, and Alabama, and

[8] The importance of this relationship of out-of-pocket costs to value of product lies in the fact that freight absorption, under a non-f. o. b. system, will occur only until the mill-net thus realized is down to the level of out-of-pocket costs. If out-of-pocket costs are high, there is less margin for freight absorption. Technically speaking, freight absorption could reduce the mill-net to a lower limit of whichever was greater of marginal costs or average variable costs. High out-of-pocket costs would mean high average variable costs. The relation of out-of-pocket costs to total costs in certain manufacturing industries is shown in appendix B of this chapter, p. 317.

phosphate rock, concerning which the following statement is made:

There are two major sources of this product, Tennessee and Florida. Apparently the Tennessee product is somewhat superior in purity to that in Florida, but its cost of extraction is materially greater. Consequently, the Tennessee producers make little effort to compete with the Florida pebble in most markets but confine their sales to superphosphate producers located in Tennessee. Selling to this restricted market, there is no need for freight equalization and they can operate on a straight f. o. b. basis.

The Florida pebble mines are themselves located within a fairly narrow geographical area, and most of the product is shipped north by boat. Variations in the locations of individual mines do not affect the freight charges appreciably and can be ignored. As a result, there seems to be no pressure for any form of freight equalization, and prices are quoted on a straight f. o. b. basis.[9]

Equalization Schemes—Basing Point Pricing

Of the various forms of freight equalization schemes, the most spectacular is the single basing point system. This system usually reflects a situation in which one seller, or one producing location containing several sellers, is or has at one time been dominant in the industry. Examples of this historical evolution are Pittsburgh in the steel industry, and the Lehigh Valley in cement production, before multiple basing point systems developed in these industries. The single basing point system is also frequently associated with price leadership, where a seller at the basing point determines the general level of prices for all sellers merely by determining the base price. The single basing point system likewise may occur when all sellers are concentrated in a fairly small area (though not small enough for all points to have a single freight rate to the rest of the country). The substitution of a common freight basing point is made in order to simplify the delivered price structure as an aid in price maintenance (e. g., maple flooring). Other examples of single basing point systems include zinc (except electrolytic), copper (except lake), industrial benzol (Omaha and west), gasoline (group 3 district), and range boilers (west of the Mississippi). Considering each make of automobile as a single standardized product, the "f. o. b. Detroit" pricing system bears some resemblance to a basing point system for those automobiles with outlying (e. g., Pacific coast) assembly plants.

Some multiple basing point systems have evolved from formal or informal single basing point systems, as in the case of the steel and possibly the cement industry. Other basing point systems seem to have arisen independently, from previous f. o. b. systems, by sellers' attempting to extend their markets but fearing to cut quoted prices (either their own f. o. b. prices or, by absorbing more freight than necessary to meet a rival's offer, another seller's delivered price). In other cases the multiple basing point system may have been adopted by agreement among producers who have been practicing unsystematic freight absorption. One object may be to simplify the pricing system, making possible "open pricing," so that every seller can know every other seller's delivered prices in order not to cut below them inadvertently. In all cases, basing point and other freight absorption systems arise in industries in which there exists a considerable margin between out-of-pocket and total costs—i. e., industries with heavy fixed costs. The heavy burden of overhead charges puts pressure upon sellers to gain, through freight absorption, added sales which, although not yielding the highest price, at least give a mill-net covering something more than out-of-pocket costs.

According to Nelson and Keim,[10] and others, multiple basing point systems or "systematic freight equalization" (a basing point system with all production points named as basing points) occur in the case of of the following products:

Steel.	Window glass.
Cement.	Heating boilers and radiation.
Pulp.	Sulphuric acid.
Sugar.	Sodium hydroxide.
Muriate of potash.	Sodium silicate.
Oak flooring.	Hydrochloric acid.
Southern pine.	Anhydrous ammonia.
Salt.	Sodium bicarbonate.
Binder twine.	Liquid chlorine.
Lime.	Hydrogen peroxide.
Bare and weatherproof copper wire and cable.	Tribasic sodium phosphate.
Floor tile.	Nitrocellulose.
Sewer pipe.	Acetic acid.
Gypsum plaster.	Sodium bichromate.
Prepared roofing.	Tribasic calcium phosphate.
	Aluminum sulfate.
	Soda ash.

The Federal Trade Commission adds the following cases of alleged use of a basing point system, at least under NRA codes:[11]

Lye.	Laundry and dry-cleaning machinery.
Wholesale coal.	Cotton ginning machinery.
Anti-friction bearings.	Refractories.
China and porcelain.	

We have already referred to the practice of unsystematic freight equalization, under which sellers sometimes attempt to extend sales by undercutting rivals' delivered prices—because of lack of foresight, and hence failure to expect retaliation in kind, or in expectation that it can be done secretly. This practice of course gives rise to unsystematic retaliation. Because it is unsystematic on all sides, no seller ever

[9] Nelson and Keim, *op. cit.*, p. 325.

[10] *Op. cit.*, p. 345.

[11] Temporary National Economic Committee, *Hearings*, pt. 5, p. 1897.

knows exactly what delivered prices his rivals are quoting, and hence to be certain of at least meeting his rivals' delivered prices, he perhaps undercuts them unintentionally. Intentional or unintentional price cutting thus tends to force all delivered prices down toward out-of-pocket delivered costs.[12] Many branches of the lumber industry are particularly subject to this condition, and most other industries using equalization schemes on certain occasions, e. g., in depressions, fall into unsystematic price-cutting of this type. At times spokesmen for basing point industries have seemed to insist that such exceptions to the system were the rule in that industry.[13]

Equalization Schemes—Uniform Delivered Prices and Zone Prices

Uniform delivered prices on standardized products may be accompanied by a tacit or overt division of the market. Usually, however, the uniform delivered price means that each seller is attempting to sell, in common with other sellers, on a national, or at least a regional basis (i. e., there is overlapping of markets).

A uniform delivered price is reported to be used in the sale of the following largely standardized products: [14]

Brass and copper sheet, tube, rod.	Cadmium.
Rayon yarn.	Snow fence.
Manila rope.	Many kinds of electric wire.
Leather transmission belting.	Aluminum.
Plumbing fixtures.	Electrolytic zinc.
Cellulose acetate.	Mahogany.
Butyl acetate	Turbine generators and condensers.
Coal-tar dyes.	Silico manganese.
Batteries.	

Although sellers of a differentiated product may adopt uniform delivered prices, all sellers need not adopt the same uniform price. When sellers of a standardized product charge uniform delivered prices, each must obviously charge the same uniform delivered price as the other.

It is almost impossible to discuss zone pricing systems in general terms because there are so many possible patterns of zone pricing. Study of specific zone pricing systems, however, might prove very illuminating. With a nonstandardized product, sellers need not use the same zone divisions, nor quote the same prices in each zone (prices need not even vary between zones in the same fashion). With a standardized product, most sellers might sell in only a single zone, at least from any single plant, giving in effect uniform delivered prices to limited markets. There might be a different zone for each seller, or the zone boundaries might include several sellers. The most important consideration is the relation of the delivered prices in the various zones to average freight rates. A zone system could approximate a single or multiple basing point system, a uniform delivered price system, unsystematic freight equalization, or the exploitation of differing elasticities of demand in different areas within a seller's own market.

Zone systems are used in the following industries, but further study of each case is required before the reasons and effects can be understood:

Doors.	Methyl alcohol.
Insulation board.	Carbon tetrachloride.
Linseed oil.	Carbon black.
White lead.	Cyanamid.
Office furniture.	Hydrochloric acid.
Flake calcium chloride.	Paper products.
Mixed fertilizers.	Valves.
Dry cells.	Hydrants and fittings.
Plastic insulators.	Bathtubs.
Panel board.	Soap.
Pole-line hardware.	Vitrified clay sewer pipe.
Power cable.	Carbon dioxide.
Rubber covered building wire.	Automobile tires.[15]

We have now reviewed, in as brief compass as possible, the various types of geographical pricing policies, indicating important users of each type and some possible reasons connected with their adoption. To some extent, these reasons may be related to the consumer reaction to the relative delivered prices, one pattern of delivered prices being more profitable than another. In larger part, they have to do with competitive relations: perhaps an attempt to keep potential competitors from entering the field, perhaps stabilizing the relations among existing competitors. In other cases they reveal an attempt by sellers to expand the geographical scope of their sales at the expense of their rivals, without inciting general price warfare. That substantial differences exist between the geographical pricing situation for sellers of differentiated and of standardized products must also be emphasized.

[12] Of course, if this logical end-result were to be achieved, there would no longer be unsystematic freight equalization. The result would be an f. o. b. pricing system. Actually, it is only in certain markets that the price-cutting develops, and it probably rarely proceeds so far that all sellers are driven out of the market except the seller with the lowest delivered marginal costs.

[13] See, for example, the testimony of B. F. Fairless before the TNEC on January 27, 29, 1940 (*Hearings*, pt. 27). This line of argument was not followed in the three-volume United States Steel TNEC Papers, separately published and introduced as testimony in the same hearings. On this point the Department of Justice's statistical inquiry into the steel prices seems to show that in February 1939, at least, the "basing-point formula was honored more in the breach than in the observance." (TNEC *Hearings*, pt. 27, p. 14141.)

[14] Nelson and Keim, *op. cit., passim.*

[15] *Ibid.*; and TNEC Hearings, pt. 5–A.

What, now, are the locational results of these systems?

Locational Results of Price Policies

The pricing policy followed by a firm or an industry could have either or both of two kinds of locational influence: it could affect the locational distribution of the firms practicing the policy; or it could affect the locational distribution of the firms' customers (in cases where these, too, are business enterprises). We shall indicate first the possible effects of pricing policies upon the firm or firms employing them.

Effects on the Industry Employing the Policy

Any pricing policy which has the effect of eliminating or preventing the entry of potential competitors by keeping delivered prices unnaturally low in areas where potential competitors might develop, clearly reduces the number of producing locations, concentrates production at fewer points, and consequently does have a very direct and obvious locational effect. The deliberate use of a geographical pricing pattern for this purpose may not, indeed, be a frequent occurrence, but such a pattern may have potent effe ts in directing the flow of new sellers into the field.

F. o. b. Versus "Equalization" Systems

Because the f. o. b. system is an "exclusive area" system (for a standardized product), an f. o. b. seller either holds a market as an exclusive area or is completely unable to sell in that market. Thus the f. o. b. system places more of a premium than do "equalization" or "freight absorption" schemes on being nearer to important markets than are one's rivals, unless lower production costs at a more distant point offset the higher transportation cost.[16] If the market for the product is geographically extensive, or if a seller's production is greater than the demand at any single market point, f. o. b. selling tends to scatter sellers fairly evenly over the total market, each necessarily fairly close to the center of the area which he serves. The seller under equalization systems, however, is more likely to locate at a cheap source of labor, power, or materials, than with reference to his market. Likewise, he can remain longer at a locationally obsolete producing point, avoiding or reducing the possible capital loss consequent upon moving.

Thus, for example, despite the movement of important centers of steel consumption westward, away from Pittsburgh and Buffalo, the pressure upon producers in these areas to relocate nearer to the new markets is reduced by the prevailing basing point system. Through freight absorption, they can share these western markets, without having to accept from their local and eastern markets the same level of return—a level which might be prohibitively low if it were forced to apply to all sales. As a matter of fact, with the virtual cessation of the westward movement of markets, the cost advantages, either natural or acquired, together with the continuance of the inherited pricing system, seem in recent years to have allowed these centers to have at least held their own.

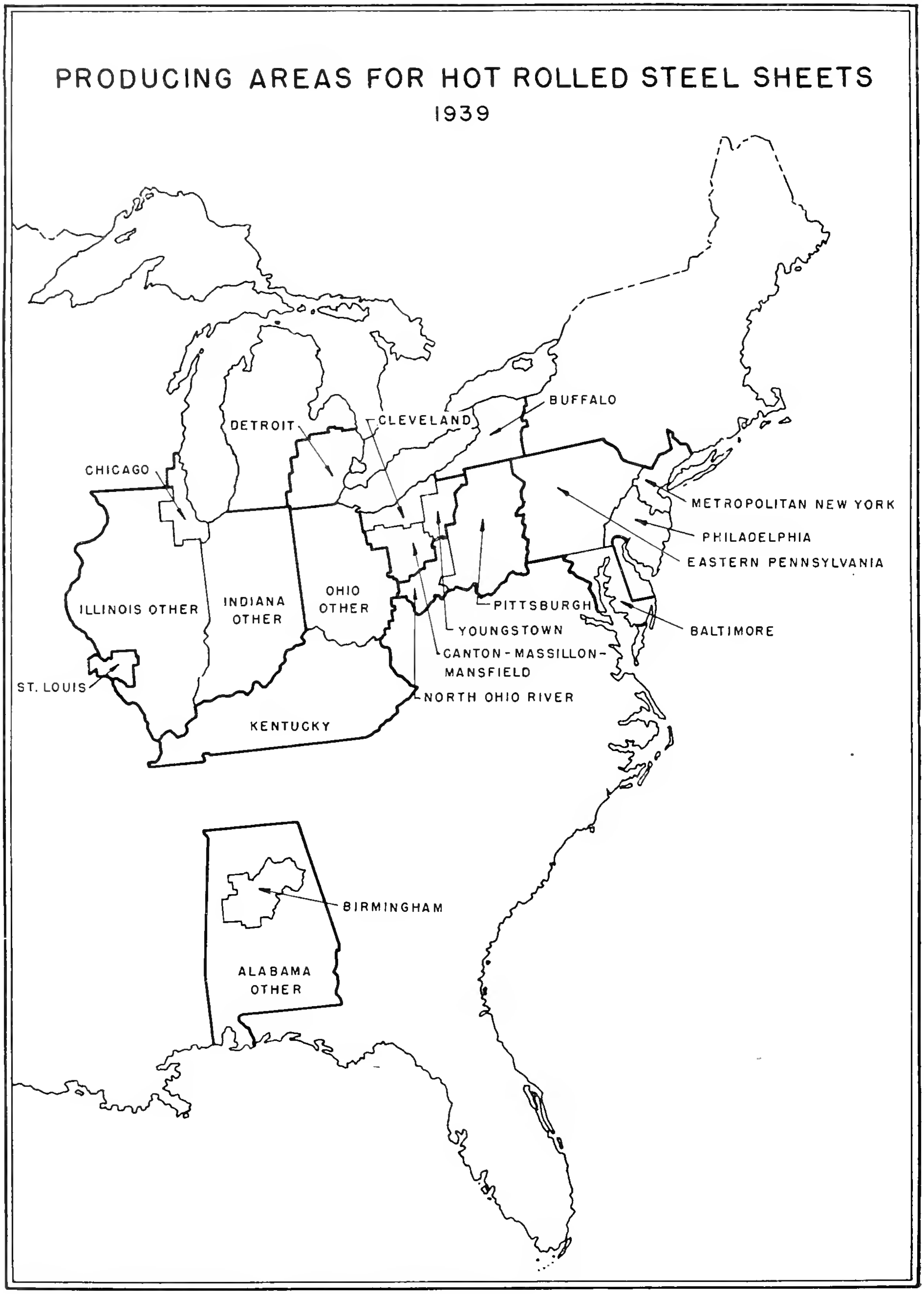
That there is this difference between the locational forces exerted under the f. o. b. and the basing point systems is admitted by the steel industry as well as by opponents of the existing practices. As the Federal Trade Commission very correctly points out,[17] the statement by the United States Steel Corporation that "the location of production facilities has been due to the fundamental economic traits of the steel industry, * * * rather than to any pricing systems,"[18] is essentially inconsistent with the more frequently expressed contention that a change from basing point to f. o. b. pricing would cause extensive dislocation, making it difficult for many existing mills to find markets. "It would destroy the investment in many plants. It would also act injuriously on many local communities whose welfare is dependent upon the steel mills at that point [sic]."[19] No clearer statement is needed to show that various geographical pricing systems do have different locational effects. Apparently admitting in this way that f. o. b. pricing would cause relocation of the steel industry nearer the principal markets, the Corporation goes on to argue that such location would be "uneconomic" because it "ignores the fact that more than 4 tons of raw materials would have to be hauled to these scattered mills for every ton of steel produced. If they were located outside the northeastern United States they would be farther from raw materials than the corresponding capacity is today, and their assembly costs would be higher. * * * It is obvious that it is cheaper to haul 1 ton of finished steel a long distance to consumer, than to haul more than 4 tons of raw material a shorter distance to a steel mill, although freight

[16] In agriculture, forestry, or mining, the disadvantage of location distant from market is usually systematically offset by a difference in rent costs or purchase price for the land, in the absence of more intensive competing uses. This would rarely be the case for industrial producers for whom immobile factors of production (land) form an insignificant portion of total expenses.

[17] TNEC *Hearings*, pt. 27, pp. 14591–2.

[18] TNEC *Hearings*, pt. 27, p. 14649.

[19] *Ibid.*, p. 14677. The American Iron and Steel Institute believed in 1935 that disturbance to the basing point system would "seriously decrease production in some of the largest producing centers such as Pittsburgh and Youngstown, and increase production at plants that are favorably located in or near the large centers of steel consumption." (*Basing Points and Competition in Steel*, p. 8.)



Source: Temporary National Economic Committee *Hearings*, pt. 27.

Figure 95

rates on raw materials are somewhat lower than on finished steel products."[20] Of course, if it were true that relocation nearer markets would increase assembly costs more than it would decrease delivery costs, then the relocation would not be expected to occur under f. o. b. pricing.

From the locational point of view, the most significant feature of a multiple price base in the steel industry is not the mutual market interpenetration and consequent "cross-hauling" but the fact that the market interpenetration is not entirely reciprocal. Some sellers must go afield for a larger proportion of their sales than others, who are better located with respect to markets, are required to do. Although cross-hauling of freight may be very significant from other points of view,[21] it is not in itself a locational problem. To the extent that cross-hauling is constituted of truly offsetting shipments, it is neutral locationally.

Table 1, based on the questionnaire (Form B) sent to the steel industry by the Department of Justice for the TNEC inquiry, applies to a single steel product (hot rolled sheets). It shows how the basing point system allows certain surplus producing areas to share in distant markets without at the same time losing control over their home markets. Similar tables could be presented for other products.[22]

The Pittsburgh-North-Ohio-River District, for example, with a surplus of 30,704 tons, lost to invaders 1,603 tons of consumption in the home area. While it might be expected under an f.o.b. system to gain these 1,603 tons for its exclusive market area, the necessity for disposing of the rest of the 30.704 tons surplus in distant markets would force home market prices very low, especially so because the Pittsburgh area is surrounded on most sides by other surplus areas, whose f.o.b. prices would probably tend to be about equal to the Pittsburgh f. o. b. price plus freight from Pittsburgh. Under the basing point system, Pittsburgh area producers share in the distant markets without the necessity for the lower prices in the home markets.

TABLE 1.—*Distribution of shipments received as compared with shipments made by producing areas, of hot rolled steel sheets, February 1939*

Area	Shipments received in area (consumption)	Shipments made by area (production)	Shipments received in area from identical area (home consumed)	Shipments received in area from other areas (imports)	Amount produced minus amount consumed (surplus or deficit)
All producing areas	155, 881	190, 910	81, 203	74, 678	+35, 029
Chicago, Indiana other, Illinois other	40, 114	41, 964	25, 738	14, 376	+1, 850
Pittsburgh, North Ohio River	6, 044	36, 748	4, 441	1, 603	+30, 704
Youngstown, Cleveland, Canton, Massillon, Mansfield	23, 295	36, 711	12, 573	10, 722	+13, 416
Detroit	46, 153	29, 792	19, 435	26, 718	−16, 361
Baltimore, Philadelphia, eastern Pennsylvania, Metropolitan New York	22, 921	15, 155	11, 774	11, 147	−7, 766
Kentucky, Ohio other	9, 844	12, 865	4, 378	5, 466	+3, 021
Buffalo	3, 287	8, 246	1, 109	2, 178	+4, 959
Birmingham, Alabama other	1, 038	6, 752	992	46	+5, 714
St. Louis	3, 185	2, 677	763	2, 422	−508

SOURCE: TNEC. *Hearings*, pt. 27, table 13, p. 14,396. All figures net tons. Boundaries of districts shown on figure 95.

Thus far we have argued in terms of the multiple basing point system, but the general conclusion that it reduces the force of the locational pull of the market can be applied as well to other systems which allow freight absorption—uniform delivered price, zone, unsystematic freight equalization.

A second locational generalization applicable to all such systems can also be advanced, although its importance can hardly be weighed in any but the most general terms. It is frequently urged in support of the multiple basing point and other equalization schemes, that since a seller (or group of sellers located together) takes a fractional slice of a geographically extensive market rather than exclusive possession of a smaller market, the individual seller is less subject to fluctuations of demand which affect only individual localities. The wider market gives some spreading of risk of fluctuations, with a chance that reduced sales in one region will be offset elsewhere. If this argument is correct, it follows that plants for which the risk of fluctuation is so reduced can be built on a larger scale. That is, there would be fewer, larger plants, operated more nearly at capacity. Aside from the possible effects on the level of costs, this carries the locational implication of a smaller number of producing centers, and a greater geographic concentration of production.

It should be emphasized that the ultimate judgment in favor of or opposed to the multiple basing point or other pricing system must be made upon additional grounds than those relevant to a study of location.[23]

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[20] *Ibid.*, p. 14676 and note.

[21] Any shipping of the same commodity both in and out of a particular area of steel involves transportation waste, whether cross-hauling occurs or not, because of the lower freight rates on long hauls relative to short hauls. At the present time abolition of cross-hauling is being urged in some quarters in order to economize on railroad rolling stock.

[22] For similar comparisons on the basis of different areal units, see the complete set of tables based on Form B in TNEC *Hearings*, pt. 27, pp. 14331–14281, and Prof. de Chazeau's summary of those results, pp. 14133–42.

[23] Such additional grounds have to do with questions of relative levels of costs and prices resulting from the effects of the pricing system upon the degree of competition in the industry. It is argued very forcibly (by Professor Fetter, for instance, and by the Federal Trade Commission) that the basing point system is an instrument of monopoly, frequently causing a higher and more rigid level of delivered prices than would be achieved under f. o. b. pricing. No opinion on this general issue is required in connection with locational questions, but many thoughtful economists have expressed a general skepticism toward the F. T. C. attitude that the compulsory adoption of an f. o. b. system would in and of itself give to consumers a generally lower level of prices for steel, cement, and similar products. In this connection it should be noted that the present opinion of the Federal Trade Commission as to what pricing system should be substituted for basing point pricing is not entirely clear. Recent utterances specifically disclaim any avowal of strict f. o. b. pricing. Yet if freight absorption is to

Thus far it has been shown that systems involving freight absorption favor, relatively to f. o. b. pricing. locations more distant from markets. But as between two locations equally well-placed with respect to markets, does the system favor the one designated as a basing point, or the one not possessing basing point status? The question of this type perhaps most widely debated has to do with the locational forces operative under a single basing point system. Did the old Pittsburgh plus system encourage mill locations at Pittsburgh or away from Pittsburgh? Some have argued that it encouraged location away from Pittsburgh, by keeping prices high in outlying regions, thus "holding an umbrella" over the outlying producer, who could collect "phantom freight" on shipments to nearby points (he included freight from Pittsburgh rather than from his own plant). Others have argued that it encouraged location at Pittsburgh. At that point, a seller could sell in all directions with the same mill net from all sales. Located away from Pittsburgh, a lower mill net would be received from sales near or beyond Pittsburgh.

Clearly, the question cannot be answered without reference to costs of production, relative to Pittsburgh, as of some particular location and size of plant. If the costs of a new firm were to be higher than the Pitsburgh base price—for reason of small initial size or for any other reason—location away from Pittsburgh was imperative. A producer who could not dispose of his entire output in a direction freightwise away from Pittsburgh was at a disadvantage selling back more than about half way toward Pittsburgh. A small producer who could sell all he produced in a local market or in one more distant from Pittsburgh was "under the umbrella."

If one could assume that assembly and production costs for any plant above a certain minimum size, located in, say, Chicago or Birmingham, were not far above costs in Pittsburgh, then it might be argued that these locations were favored so long as facilities there were insufficient to supply the local demand. Once they could no longer increase their shares of the local markets and were forced to sell very far toward Pittsburgh, they were penalized.[24] But compared with an f. o. b. system, even the necessity for freight absorption on sales toward Pittsburgh was better than the necessity, under f. o. b. pricing, for a price cut on all sales in order to sell toward Pittsburgh. On the other hand, under f. o. b. pricing, a slight price differential under Pittsburgh-plus would have given exclusive possession of the local market and large sales without the necessity for selling very far toward Pittsburgh.

The steel industry furnishes an excellent example of the tendency of an industry with a large proportion of standardized products bearing high transportation costs to abandon a price system based on too few basing points. Although Chicago producers were favored by the high local delivered prices, economic pressure ultimately caused Chicago to become a basing point. The basis for this pressure is frequently incorrectly stated. Declaration of a base price at Chicago less than the Pittsburgh-plus price did not mean that Pittsburgh producers were excluded from the Chicago market, or even held any smaller share of it than before; merely that all received lower mill nets. But because of an elastic consumer demand which was very important in Chicago,[25] a lower delivered price was expected to give enough additional sales, even though shared by Pittsburgh producers, to make such a move more profitable. The optimum delivered price at Chicago for Chicago producers became lower than the optimum delivered price at Chicago for Pittsburgh producers, once production costs at Chicago became sufficiently low. The outlying producer, protected by freight rates, has motive to reduce his delivered prices by becoming an independent basing point, for exactly the same reason that any monopolist has for lowering prices. A price can be too high, even for a monopolist.

If the number of basing points in a basing point industry is artificially restricted (i. e., if there are producers who would become basing points if not deterred by tradition, or by threat or fear of retaliatory

be allowed, under a mill-base system (all mills basing points) or under unorganized freight equalization (how secured?), many of the F. T. C. objections to the basing point system (on grounds of cross-hauling, price discrimination, etc.) lose their force. At one point the Commission has argued that prices should be quoted f. o. b. mill with "no obligation to maintain any announced price for any time whatsoever." As an alert steel buyer points out (*Iron Age*, April 20, 1939, reprinted in TNEC *Hearings*, pt. 27, p. 14434) this would allow continuance of any delivered pricing practice whatsoever, merely by quoting a different f. o. b. price to every customer. The Commission admits that it has argued that pressure of buyers would enforce the *same* f. o. b. price to all, but that the law (Clayton Act) allows discrimination in good faith to meet competition, a right which the Commission has never questioned. Then follows this statement: "If the * * * substitution of f. o. b. mill prices did not operate to prevent a mill from charging different prices to its different customers, this would be taken care of under the law as it now stands *if it amounted to unlawful price discrimination*." (FTC "Analysis of the Basing Point System of Delivered Prices as Presented by United States Steel Corporation in 'Exhibits Nos. 1410 and 1418,'" TNEC *Hearings*, pt. 27, p. 14,597. Italics inserted). Whether the Commission believes that discrimination of the sort involved in the basing point system (or its continuance under the guise of f. o. b.) is or is not illegal remains in doubt. The Temporary National Economic Committee has recommended legislation to make the basing point system specifically illegal. The apparent intent of the framers of a previous "antibasing point" bill would merely have forced all mills to become basing points. See Senate Interstate Commerce Committee *Hearings on S. 4055*, 1936.

[24] Actually, evidence seems to show that during the Pittsburgh Plus period, the Pittsburgh share of total capacity was declining relative to other areas. See Carroll R. Daugherty, Melvin G. de Chazeau and Samuel S. Stratton, *Economics of the Iron and Steel Industry*, New York, 1937, Vol. I, pp. 334–7.

[25] One reason for the elasticity of the demand is suggested on p. 314.

action by existing basing point producers), then *ipso facto* we can conclude that continuance of the system favors location of new firms or expansion of existing firms at existing basing points. Complete freedom for any seller to declare his mill a basing point would prevent any discrimination against such nonbase locations owing to their inability to charge the most profitable delivered prices in the local markets, rather than delivered prices set at the most profitable level for producers located at existing, distant basing points. Given this freedom, it is probably correct to say that a multiple basing point system does not necessarily favor location either at or away from existing basing points, although, as we have previously noted, by reducing the strength of the locational pull of the market, it allows greater advantage to be taken of lower production cost locations.

Thus far the treatment of the locational effects of geographical pricing policies has been restricted to a discussion of the pricing of standardized products. It should be evident from the discussion of the effects of geographical pricing policies when the product is differentiated, that the attempt by a seller to differentiate his product from that of other sellers carries a definite locational implication very similar to the locational implications of equalization schemes. A seller in an industry of a standardized product may have a choice of several ways in which to expand, if expansion requires the selling to a geographically more extensive area. If his is an f. o. b. industry, he can achieve a wider sales area by a reduction in his f. o. b. price; or he can maintain prices in his own sales area, but abandon f. o. b. pricing elsewhere by absorbing enough freight to meet (or perhaps to undercut) the delivered prices of his neighboring rivals; or he can attempt to differentiate his product from that of his rivals, so that he can sell at distant points even at delivered prices higher than those of his rivals. Each of these policies may improve his position, if his rivals do not retaliate in kind.

The degree to which retaliation to each of these policies is expected is one of the factors determining which method of attempted expansion will be chosen. Sellers are likely to realize the fruitlessness of f. o. b. price cutting; the act is such a palpable challenge that it is sure to be met. If f. o. b. selling were made compulsory in many industries now practicing basing point pricing, price cutting to gain sales could hardly be expected, except by sellers disadvantageously located. Freight absorption—especially if it is merely to meet but not to undercut delivered prices of rivals—seems to be a less drastic step. It does not appear as much like price cutting, because quoted prices are unchanged. And it does not necessitate a lowered return from sales to existing customers. Yet if the freight absorption takes sales from rivals, they may be forced to retaliate with similar action. The result may be a mere exchange of high for low mill net sales, unless, of course, the area to which the first seller can penetrate by freight absorption contains more business than that part of his own area which rivals can reach. Still less certain of any exact retaliation is the attempt to extend the sales area by product differentiation, perhaps accompanied by a uniform delivered price. Really successful establishment of a new variety of a previously standardized product may defy any attempts to duplicate the feat; it may give a firm previously confined to a local market a permanent hold on a larger national market.

The reasons for the adoption of product differentiation resemble the reasons for freight absorption; and the locational effects are likewise similar. The increasing emphasis in recent decades upon trade names and advertising may thus have had the effect of reducing the locational pull of the market, concentrating production at a smaller number of locations (depending on scale economies) scattered according to a pattern based more on production costs and less nearly approximating the distribution of final consumers.

Locational Effects Upon Consuming Industries

That a geographical pricing policy may affect the geographical structure of the industry practicing it seems not to be open to doubt, although the results are extremely difficult to predict. It is equally true that such policies may affect the locational structure of customer industries; and, fortunately, at least some of this class of locational effects are more obvious and more capable of successful description. It is difficult to conceive of price policies having any direct effect upon the location of final consumers. This means that we need not consider any secondary locational effects of product differentiation, which is largely designed to appeal to final consumers.

Pricing policies will affect the location of customer firms (whom we shall call "fabricators," for convenience) to the extent that these firms are material-oriented, and oriented to the particular material to which the price policy applies. If fabricators are inevitably located at the final market for their product, a price policy adopted by the seller of one of their materials would have no locational significance as far as they are concerned.

Only when price policies are altered do their locational effects stand out with any clarity. When such

changes are made, one group of fabricators feels itself penalized and calls attention to the locational effects of the policy by its protests.

Establishment of a basing point for steel at Detroit, for instance, widely demanded by the automobile industry, with a base price equal to Cleveland's or only slightly higher, would have changed seriously the competitive positions of Detroit and Toledo steel fabricators. As a compromise, a special delivered price for the Detroit area was set up, which penalizes producers just over the Michigan borderline into Ohio, but without giving as great an advantage to Detroit fabricators as they desired. Several arbitrary changes in the number of basing points, and the ending of special exceptions to the basing point system, were made by the NRA steel code; a fact which caused a storm of protest from fabricators in Youngstown, St. Louis, Duluth, Fostoria (Ohio), and other points, whose claim was that previous basing points at these places, or equivalent concessions, were eliminated by the code.[26] Likewise, the declaration in June 1938 of many new basing points and the lowering or elimination of base price differentials at the previously existing basing points was hailed as a great boon to fabricators located at or near the new basing point cities.

Following the reasoning introduced in previous chapters, if a material is priced on an f. o. b. basis, fabricators whose process is oriented toward that material (because of substantial weight loss in conversion, for example), tend to locate at the actual sources of production of that material. Thus, if transportation rates represent transportation costs, the concentration of such producers at the source of their material not only is more profitable for them, but results in a minimization of the drain upon society's transportation resources.

The most spectacular negation of this social advantage occurs in the case of a material for which a uniform delivered price is charged. The fabricator using such material now has no motive whatsoever to locate near to its source. The cost of the material to him being the same at all points, it no longer enters as a locational factor; we cannot say that his process is oriented toward this material. He may now locate at the source of some other material, at a point of low labor costs, or at his market, and transportation costs are no longer minimized. If such a pricing policy does in fact cause fabricators to locate farther away from the sources of their material than they would under an f. o. b. system, the burden of freight absorptions for the primary producers is increased, and the level of delivered prices may have to be raised to cover the increased cost. Yet there is still no motive for fabricators to correct the situation by relocation nearer to sources of supply.[27]

A single basing point system has somewhat similar tendencies. Under such a pricing plan, fabricators, if material-oriented, tend to locate at the basing point, although a portion, perhaps a large portion, of the primary material is produced elsewhere. This necessitates longer hauls by the nonbasing point producers. In fact here we introduce a qualification to the previous argument regarding the effect of the basing point system upon the location of the sellers practicing it. In discussing that question we had assumed that the location of the market for the product was fixed, and was independent of the pricing system. Once we introduce the possibility that at least some of the users of the product are material-oriented fabricators, the earlier argument needs modification. For if users of steel, for example, tended to concentrate at Pittsburgh under the old Pittsburgh plus system, then the system conveyed an additional advantage to Pittsburgh steel producers and disadvantage to steel producers located elsewhere. This gives us, too, an answer to the question: why should any nonbase seller wish to have his mill made a basing point? The designation of a mill as a basing point, with lower delivered prices than in surrounding territory, has the additional advantage of attracting fabricators—a special form of elasticity of local demand.[28]

An example of the centralizing force of a single basing point system is the continued concentration of brass mills in the Connecticut Valley, in part enforced by the basing of electrolytic copper prices on New York, although electrolytic refineries also are found in Great Falls, Mont., Tacoma, Wash., El Paso, Tex., Inspiration, Ariz., and St. Louis, Mo., and lake copper refineries in northern Michigan. These refineries have,

[26] See Federal Trade Commission's Reports to the Senate (Senate Doc. No. 159, 73rd Congress, 2nd Session) and to the President with respect to the Iron and Steel Code of Fair Competition.

[27] In the case of heavy producers' goods, the fabricator who pays no attention to their source of supply runs a distinct risk of a change in price policy. This factor, and the factor of convenience and speed of delivery, modify the above argument.

[28] Mere designation of a mill as a basing point may not be sufficient to attract fabricators. The new base price must be less than the old delivered price by more than the difference between the cost of transporting the material and the cost of transporting the equivalent amount of fabricated product from the original basing point to the new point. For example, because the base prices on steel at Pacific coast ports are only slightly (if at all) less than base prices at eastern basing points plus ocean freight from eastern bases to Pacific ports, Pacific coast fabricators have great difficulty in competing with eastern fabricators, who can buy their material at the eastern base price and deliver the fabricated product (because of weight loss in conversion) at a lower delivered cost on the Pacific coast than can the local fabricators. (The Pacific coast fabricators' handicap is made even worse by the fabrication-in-transit privilege. See TNEC *Hearings*, pt. 20, pp. 10912–10918.)

under the present pricing system, no attractive forces for fabricators.[29]

The multiple basing point system, then, exerts a decentralizing force on fabricators, as compared with a single basing point system, provided that base prices are sufficiently equal to attract fabricators to all basing points. The only differences between the locational effects upon fabricators of multiple basing point and f. o. b. systems would concern nonbase mills, and the probability that relative base prices might diverge from the corresponding relative f. o. b. prices.

The general nature of the effects of zone pricing system on the location of fabricators would depend, again, on the general nature of the zone system. If it were a mere approximation of f. o. b. pricing, its effects would be similar; or if it had the general pattern of a basing point plan, the locational results would resemble those of that system. If, on the other hand, the zone plan were related to elasticities of demand, and provided a method of extracting maximum delivered prices from areas where high prices had the least effect in reducing sales, and low prices where demand was most elastic, then the locational results might be extremely unfavorable from the point of view of social cost minimization. For it might be that the reason sales were so easily checked by higher prices in the zones where low delivered prices prevailed was simply that these were areas of high production costs or of unfavorable location from some other point of view; the reason for the inelasticity of demand in areas where the higher delivered prices were set, the fact that these were favorable fabricating areas. The discrimination among the areas, then, could mean an artificial subsidy to inefficient producing locations at the expense of the more efficient. This would be true, of course, only under the circumstances in which relative zone prices did not reflect relative production plus transportation costs. And it might by chance be possible that the areas of most elastic demand would be those areas nearest the producing centers and of least elastic demand those areas farthest from the production area; in this case the discrimination would increase the tendency for fabricators to locate near to the source of their material.

One additional feature of zone pricing which deserves comment is the necessary existence of sharp breaks in the pattern of delivered prices—a distance of a mile, perhaps, causing a substantial difference in the delivered cost of the purchased material. This fact would tend to concentrate material oriented fabricators on the edges of lower priced zones nearest to adjoining higher priced zones. If the Mississippi River, for instance, separates an eastern lower priced zone from a western higher priced zone, fabricators not bound to markets will locate on the eastern side of the river, with few located between the Mississippi and, say, Denver (if that point marks the beginning of a still higher priced zone), where another concentration may be found. In this way the burden of freight absorption upon the sellers of the product may be substantially increased.

Thus far the discussion of locational effects on fabricators has been confined to the effects of price policies which determine the pattern of relative delivered prices. One or two additional features of pricing policy, only indirectly connected with the determination of relative delivered prices, need final comment. In connection with a basing point system, provision is frequently made that the freight charge, to be added to the base price to give the delivered price, shall be the all-rail freight charge, even though actual shipments be made by water or by truck. Or, perhaps, truck shipments in the trucks of customers will be allowed, but only with the imposition of a penalizing addition to the base price. In the steel industry this addition has, since NRA days, amounted to 35 percent of the all-rail freight to the customer's location. This policy of discouraging the use of truck deliveries probably can hardly be said to have locational effects, for buyers desiring truck delivery do not necessarily constitute a locational class. But the penalizing of purchasers located on water shipping lanes does amount to a locational discrimination, one that has been widely attacked. The justification advanced (here again, by the steel industry) is that to allow the advantages of the lower rate for water shipments would penalize competitors of those receiving the reduction, competitors not located on navigable water lanes. As the Federal Trade Commission has frequently and vehemently charged, the inevitable result of this policy "is that the natural disadvantages of unfavorably located producers are removed by what amounts to a subsidy collected from the buyers and that the favorably located purchasers pay a price not warranted by the cost of delivery.[30]

"Prior to the code, towns and cities located on inland waterways in many cases received the benefits of cheap water transportation in the purchase of steel products. Important industries were established, mills and fac-

[29] The pricing system in copper is not strictly a basing point system, for the delivered prices at interior points exceed the New York price by less than the freight from New York. The Office of Price Administration's Revised Price Schedule No. 15 (September 12, 1941), giving lake copper the same delivered prices as electrolytic, makes the price pattern more nearly that of a single basing point system, and removes any price advantage of nearness to supplies of lake copper.

[30] *Federal Trade Commission, Report to the President with Respect to the Basing Point System in the Iron and Steel Industry*, p. 24.

tories were built, and labor concentrated at such points in the faith that the advantages of cheap water transportation would be permanent. * * * The code requirements for an all-rail base formula deprive these interests dependent on inland waterways of a large share of, and in some cases all the benefits of their location." [31]

The change in policy thus described naturally evoked much protest from affected consumers. To what extent the practice has been continued is not known.[32] While it was defended on the ground suggested above—that it equalized competitive advantages—apparently the real reason for the policy was that the delivered price concessions previously made to fabricators located on or near water routes were an uncertain and thus disturbing element in the price structure, perhaps leading to involuntary price cutting in the attempt to meet rivals' delivered prices.

An allied locational discrimination against certain groups of fabricators, which is made especially severe under any system involving freight absorptions, is the "fabrication-in-transit" privilege. Since this is essentially a transportation rate policy rather than a pricing policy on a physical product, we shall omit any discussion of its effect at this point.[33]

Conclusion

The analysis of the present chapter represents an attempt to demonstrate that pricing policies can have important effects upon industrial location. The most significant feature of these effects, from our point of view, is that they introduce an additional element of personal, administrative decision into the set of factors determining the geographical array of our industrial system. Price policies, to the extent that they are policies, are the result of individual decisions—decisions which might have been made in another way, without necessarily altering the immediate or ultimate profitability of the industry. Or in some cases they may alter the profitability of one industry, or one group of sellers, but perhaps only at the expense of another group of sellers, another industry, or the final consumer. The important fact is that a pricing policy implies a human choice among alternatives.

Of course, every business decision is a personal decision, a choice among alternatives. There are no impersonal "economic forces" which determine what shall be produced, by whom, or at what geographical point. Economic analysis, as the "institutional school" of economists is so fond of pointing out, is an analysis of human behavior. What then is the point of the above emphasis upon pricing policies as a more "arbitrary;" a more "administrative" decision? It represents simply a return to the opening paragraphs of the chapter, where it was indicated that for pricing policies to exist, there must be some degree of imperfection of competition. Despite all of the modern skepticism toward "classical" economic analysis, with its quasi-mechanical representation of human behavior in terms of "natural law" and with its inevitably logical prescription of laissez-faire, it remains unalterably correct that, given these writers' assumption of an institutional framework of perfect competition (and a human nature built around self-interest), they were entirely correct in their description of economic "forces" or "laws." Perfect competition does give the seller, if he is to remain a seller, no choice but that set for him by the market. Imperfect competition, to the degree that it does exist, does give freedom for choice of price policy (and other matters)—and introduces an indeterminacy into the results which gives free play to all sorts of psychological factors, allowing reflection of the vigorous personality of a Ford or a Firestone, or the traditional, largely unthinking adherence to an inherited way of action. The locational effects of a price policy are thus of a somewhat different order from the locational effects of nearness to materials or market, economies of scale, or of "external economies" of urbanization, for all the latter are effects which do not primarily depend upon individual decisions—decisions which might have been made in another way. Since "market forces" cannot always be relied upon (when competition is imperfect) to secure price decisions which maximize national income, there exists a genuine sphere for the appropriate exercise of public policy, through legal action or moral suasion.

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[31] Federal Trade Commission, *Report to the Senate*, p. 27.

[32] Nor is it important for our purpose, which is merely to show how this element of pricing policy can affect the locational distribution of fabricators.

[33] See, however, the Reports of the Federal Trade Commission, cited above; and TNEC *Hearings*, part 20, pp. 10914–7.

APPENDIX A

Relation of Consumer Demand to Delivered Prices of a Monopolist

There are several reasons why even the monopolist might not adopt an f. o. b. pricing policy. In the first place it is obvious that a uniform delivered price, or the use of price zones, is a more convenient form for price quotations, and it allows the use of the price in national or regional advertising. Where transport costs are relatively insignificant, this fact may be the compelling consideration, whatever the degree or form of competition. In the second place, the elasticity of consumer demand [1] may make some non-f. o. b. policy more profitable. Even if the response of consumers to the product (the elasticity of consumer demand in terms of delivered prices) is the *same* at all points in the market, the most profitable pattern of delivered prices is not necessarily the same as the pattern of delivered costs, i. e., f. o. b. It may rise more steeply than such delivered costs or less steeply.[2] In case the ideal pattern of delivered prices is a relatively "flat" one, the uniform delivered price might be a better approximation to the ideal than f. o. b. selling. By use of zones any pattern of prices steeper or flatter than that obtained f. o. b. could be approximated.[3]

If the elasticity of consumer demand varies at all widely among regions, an "unsystematic" price structure will be most profitable, with delivered prices highest in markets where sales are least checked by high prices, and low delivered prices in markets where sales are more responsive to price. This policy can be followed most easily by the absolute monopolist; yet any seller may be able to discriminate within the area in which he sets the price, no matter how many his competitors, and no matter whether his market area is an exclusive one, or whether his competitors are also selling there, accepting his prices. Likewise, the pattern of delivered prices used in common by the various members of an industry may, by design, by successful trial and error, or by accident, approximate the most profitable discriminatory pattern.

[1] Elasticity of demand is a technical concept, defined as a percentage change in amount consumers will purchase as the result of a slight price change, divided by the percentage change in the price. If a 1-percent increase in price causes a 1-percent decrease in sales, demand is of "unit elasticity." If there is a more than 1-percent decrease in sales, demand is relatively "elastic"; if less than 1 percent, it is relatively "inelastic." In mathematical terms, the elasticity is defined as $\frac{-p\,dq}{q\,dp}$, where p and q represent, respectively, the original price and the original quantity purchased.

[2] For proof of the proposition that the ideal gradient of delivered prices depends on the elasticity of consumer demand, and coincides with the transport gradient only in a special case, see E. M. Hoover, "Spatial Price Discrimination," *Review of Economic Studies,* IV (1937), 182–91; and A. Smithies, "Monopolistic Price Policy in a Spatial Market," *Econometrica,* IX (1941), 63–73.

[3] Because of legislation regarding discrimination, the chief alternatives for a monopolist would be the uniform delivered price, and the f. o. b. policy. These two policies can be shown to be equally profitable, if demand is spread evenly over the market, with amount sold at any point a linear function of price, and with constant marginal costs. For any other type of demand curve, one or the other policy would be the more profitable. (See Smithies, *op. cit.*)

APPENDIX B

Out-of-Pocket Costs and Value of Product, as Related to Pricing System

The table shows the fraction that out-of-pocket costs formed of value of product in 1937, for certain specific industries and for all manufacturing. Each of the f. o. b. industries in the list had a higher than average percentage of out-of-pocket costs; each of the non-f. o. b. industries listed (except pulp, sugar, and steel) had a lower than average percentage. Since it is specific products that are sold according to given pricing systems, and industry classifications rarely coincide with specific products, statistical illustration of this relationship is impossible. The following table is merely suggestive:

Percentage out-of-pocket costs formed of value of product for selected manufacturing industries, 1937

Industry	Labor, material, purchased power, and fuel costs as percentage of value of product
All manufacturing	75.3
F. o. b. industries:	
Motor vehicles	90
Worsted yarn	90
Leather	87
Flour	85
Woolen yarn	83
Cotton yarn and thread	81
Men's and boys' clothing	81
Boots and shoes	70
Women's, misses', and children's apparel, n. e. c	78
Freight absorption industries:	
Steel works and rolling mill products	78
Sugar, beet and cane	76
Pulp	75
Paper	74
Roofing	70
Fertilizers	70
Glass	63
Lime	63
Cement	56
Wallboard	54
Gypsum products	54
Salt	50
Drugs and medicines	36

SOURCE: *Census of Manufactures*, 1937.

CHAPTER 19. GOVERNMENTAL AND COMMUNITY INFLUENCES

By Henry M. Oliver, Jr., and Milburn L. Forth*

Federal Governmental Influences

Even if Federal governmental policy were not at all concerned with industrial location, many types of Federal action would necessarily affect the geographical distribution of industrial plants. Examples are tax collection, expenditure, and interest rate regulation. Obviously, moreover, the Federal Government has never long refrained from action intended to influence industrial location. Official planning boards and valley authorities may be the creations of a recent period; but protective tariffs and grants of public land to railroads are examples of early haphazard "planning."

Today the Federal agencies which are officially entrusted with making or administering plans for the location of industry include the National Resources Planning Board, the Tennessee Valley Authority, the Bonneville Power Administration, the War and Navy Departments, and the War Production Board. No attempt will be made to discuss the contributions of each agency. Instead the means whereby the Federal Government (purposely or not) has influenced industrial location will be considered. These may be classified as follows:

A. Means which alter the relationships among industrial costs in various areas:

1. Those altering labor costs:
   - (*a*) The NRA codes of "fair competition."
   - (*b*) Minimum wage standards.
   - (*c*) Encouragement of union organization.
   - (*d*) Social insurance.
   - (*e*) Work relief and direct relief.
2. Those altering material costs:
   - (*a*) Import duties.
   - (*b*) Governmental competition in purchasing.
3. Those altering power and fuel costs:
   - (*a*) TVA; other public power developments.
   - (*b*) Regulation of the price of (and freight rates on) coal.
   - (*c*) Regulation and indirect encouragement of the petroleum and natural gas industries.
4. Those altering transportation costs:
   - (*a*) Railway subsidies.
   - (*b*) Highway and waterway expenditures.
   - (*c*) Regulation of common carriers.
   - (*d*) Land settlement policy.
5. Those altering capital costs:
   - (*a*) General monetary and banking policies.
   - (*b*) Use of Federal credit.

B. Means which alter income relationships among areas:

1. Revenues and expenditures.
2. Customs duties.
3. Price-fixing and regulation of price policies.
4. Land settlement policy.

C. Means which help or hinder certain industries and thus influence industrial location:

1. Protective tariffs.
2. Excise taxes.
3. Governmental expenditures.

D. Other means of influencing the location of industry not owned by the Government.

1. Attitude toward basing points and market sharing.
2. Industrial research.
3. Educational and informational agencies.

E. Federal ownership and operation of industry.

This, of course, is not a complete list. Indeed, in one sense the Federal Government affects industrial location by what it allows individuals and corporations to do, and by what it forbids State and local governments to do, as well as by the types of actions mentioned above. Thus, the policy of allowing unregulated exploitation of subsoil resources has affected the location of the petroleum and related industries. And the constitutional ban upon interstate customs duties has undoubtedly affected the location of many industries.

Finally, the items in the classification obviously are not entirely independent of one another; for instance, each of the items affects areas' incomes to some extent.

Relationships Among Industrial Costs in Various Areas

Labor Costs

Probably the most important effects of Federal policy upon areas' relative labor costs have been those issuing from the NRA codes of "fair competition" and

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the Wage and Hour Act, both of which have had the same general result: the narrowing of wage-rate differentials. The NRA codes, which came into being in 1933–34, established minimum wage provisions for specific industries. The later act, passed in 1938, set upper and lower levels, between which wages boards were directed to decide minima for specific industries.

Since many workers in the South and in certain nonsouthern rural areas previously received wages below the new minima, the Federal rulings served to raise southern relative to northern and western, and rural relative to urban, wage rates. Unfortunately, data are not available for rural-urban comparison; but the following estimates help indicate the effects of the rulings in narrowing regional differentials: In 1932 the wage rate paid common labor in the South was three-fifths as high as that paid in the Nation as a whole.[1] In 1935, after the NRA codes, the southern rate was three-fourths the national average,[2] even though many of the codes provided for wage differentials in favor of the South. Estimates for subsequent years show that later developments have preserved the higher ratio set by the NRA codes.

The exact locational effects of such wage-rate changes are, of course, unknown. Other factors as well as the absolute and relative height of wage rates have decided the course of production and employment. Investigations so far seem to indicate that little unemployment has been caused by the raising of wages in the lower-wage areas, and thus that such areas have not directly lost a substantial fraction of their share of industry.[3] However, only a few years have elapsed since the passage of the Fair Labor Standards Act. Over a longer time period the diminution of the profit margin may possibly cause some firms to cease production, although they now operate because they cover out-of-pocket expenses. Furthermore, there is the possibility that maximum wage legislation has checked and will continue to check the movements of manufacturing into the South and into rural areas. For many industries the chief attraction of such areas has been a cheap and abundant labor supply; the minimum wage acts seem to have been designed partly to check the response of industry to this lure.

Locational effects of the National Labor Relations Act have probably been similar to those of the Wage and Hour Act. The low-wage areas have in general been those in which unions have been weakest and hostility to unions has been greatest. Passage of the National Labor Relations Act decreased the effectiveness of such hostility by prohibiting employer interference; and with union growth in the low-wage areas there was frequently associated an increase in both the absolute and relative height of wage rates. Since union policy is firmly opposed to the existence of wage differentials, continued increases in union strength in the low-wage areas will probably be accompanied by further narrowing of rate differentials.[4]

Federal work relief wages have varied between regions. The provision in the Emergency Relief Appropriation Act of 1939 that the WPA security wage should not vary more between regions than the cost of living led to a sharp upward revision of rates in many States, so that they approached or exceeded hourly entrance rates for unskilled labor in some regions. Because of the relatively low level of wages in the South, the work programs may have tended to reduce in some measure the competitive advantage which low wage rates in this region appeared to afford.[5]

Since social insurance taxes are a percentage of wages, they have not increased wage differentials between regions unless there have been regional differences in the extent to which employers have succeeded in shifting the tax to labor or to consumers. More important for industrial location is the fact that payroll taxes for unemployment compensation vary between States owing to the different experience-rating provisions in the various State laws. The possibilities of inter-State tax competition are obvious, and fears have been expressed that significant industrial shifts toward States with experience-rating provisions especially favorable to employers may take place.[6]

The future locational significance of Federal wage-rate equalizing, of course, will depend in large part upon whether the pull of markets and materials becomes stronger or weaker in the future. Industry not bound by materials or markets tends to seek low labor costs, and the narrowing of wage differentials may prevent much industrial movement.

Likewise, future locational significance of Federal standardization of wages will depend in large part upon whether or not industry demands as highly skilled labor as at present. If automatic machinery improves the position of unskilled labor, for this reason also the negative role of wage-rate equalizing will be increased.

[1] Estimates of the Bureau of Labor Statistics.

[2] The NRA also established a maximum of 80 hours per week for machine operation in the cotton textile industry. Before NRA average machinery hours had been well below 80 in Rhode Island, Massachusetts, and Connecticut, and well above 80 hours in Tennessee, South Carolina, Georgia, and Alabama.

[3] See "First Year's Operation With Fair Labor Standards Act," *Monthly Labor Review*, February 1940, pp. 397–98.

[4] This aspect of union policy is manifested in the NLRB decision to abolish 60 cents per diem differential between the northern and southern bituminous coal fields.

[5] For a discussion of the effects of work relief on wages, see National Resources Planning Board, *Security, Work, and Relief Policies*, 1942, pp. 348–353.

[6] See *ibid.*, pp. 335–337.

Material Costs

Direct Federal influence upon areas' relative heights of material costs is not frequently found; the influence is usually indirect, being achieved through effects on labor costs, transportation costs, etc. However, there are some examples, such as that provided by import duties on raw materials or semi-finished products. If, for instance, plants in a coastal area can buy more cheaply in the foreign market than plants in interior areas have been buying in the domestic market, the imposition of a sufficiently high tariff may destroy the advantage enjoyed by the coastal plants. The lead industry may provide an illustration here. Domestic ores are mined and smelted in the Middle Western and Mountain regions, which have by far the bulk of the lead refining and manufacturing establishments. However, the Northeastern seaboard's share of the industry might be considerably more important but for the existence of a customs duty that is fairly high relative to the value of the product and which seems to be greater than the normal price differential between New York and London.

Another example is that provided by governmental competition in purchasing. The present armament program indicates how governmental requirements may raise the cost and limit the quantity of materials available for general business purchases. If the general business purchaser is located in another area than that in which the plant selling to the Government is located, governmental purchasing competition affects the geographical distribution of industry. Certain Middle Atlantic communities producing consumers' goods have had industrial activity curtailed through the imposition of aluminum priorities. During "normal" times, of course, this type of effect is not apt to be important.

Power and Fuel Costs

The most spectacular example of Federal action which affects the relative heights of areas' power and fuel costs is, of course, that provided by the Tennessee Valley Authority, which has as one of its principal purposes the development of industry throughout the TVA region. The scope of the project is shown by the fact that the generating capacity of TVA is now nearly 1,000,000 kilowatts, or over 2 percent of the Nation's total electric generating capacity. However, a distinction must be drawn between the function of the TVA in lowering power costs and its function in undertaking industrial research to aid in the development of new industries. The research may be intended to provide new industrial uses for electricity in the Valley, but it constitutes a separate way of aiding area development.

Projects similar in some respects to the TVA are those in the Columbia and Colorado Valleys. In addition, PWA grants have been used to create quite important power centers in South Carolina, Texas, and Nebraska. In these instances the plants are locally owned.

Industrial location is also affected by Federal regulation of coal prices. This regulation consists partly of direct price fixing through the Bituminous Coal Division of the Interior Department and partly of freight rate "equalizing" by the Interstate Commerce Commission.[7] The I. C. C. makes coal rates so as to be the same from all mines within a homogeneous district and thus in part determines to a minor extent the relative prices areas must pay for the source of power still used by the great majority of American industrial plants (whether directly or indirectly through coal-generated electric power).[8]

Federal influences upon the development of the fuel oil and natural gas industries have usually been less direct. Perhaps the principal type of Federal influence upon these industries has been the stimulus which the Federal highway program has given to the entire petroleum industry. This program's chief effect on the relative heights of areas' power costs has been the provision of a cheap and abundant supply of natural gas in the petroleum-producing and adjacent districts. Increased consumption of gasoline has led the exploitation of more fields from which natural gas is liberated. In addition, the encouragement which profits have given to industrial research may have caused even fuel oil to become cheaper, in spite of the fact that from a long-run standpoint gasoline and fuel oil consumption are mutually limiting. Governmental conservation plans, of course, have tended to prevent the fall of fuel costs in petroleum-producing areas.

The locational significance of governmental influence on relative power and fuel costs is limited by the fact that power and fuel expenses usually constitute only a small percentage of a firm's total expenses; but in some industries, such as aluminum, power costs frequently are the deciding locational factor, and in many (i. e., those making important use of electro-chemical and electro-metallurgical processes) power and fuel

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[7] See ch. 9.

[8] Undoubtedly the more important influence here is that upon the ability of poorly located mines to compete more favorably with well-located mines. However, the equalizing also tends to affect relative freight rates in the following ways: (1) A lower rate from Mine X to Consuming Center Y tends to result in lower rates (because of the long-haul short-haul provision) to points between X and Y; (2) certain consuming centers are given a better supply position and others a worse, due to expansion of the areas that can be reached by certain mines. To a certain extent the two types of effects described here may offset each other.

expenses are as great as or greater than wage costs and the costs of transport.

Transportation Costs

Perhaps the most obvious of the means through which the Federal Government has affected the relative heights of areas' transportation costs have been the direct aids given to railway, waterway, and motor highway transportation. In the past century railway subsidies formed the most important type of direct aid; transcontinental railways were given valuable tracts of public land, both for rights-of-way and for purposes of sale. Greater ease of transporting men and freight to the Western States attracted agricultural settlement; and both lower freight rates to, and agricultural settlement in, the Plains States improved the industrial position of such middle western industrial centers as Chicago and St. Louis. Similarly, because lower freight rates brought access to eastern markets, the Far West was enabled to exploit its mineral, lumber, and agricultural resources; there also, cumulative effects included the development of local manufacturing. In the twentieth century construction of the Panama Canal, expenditures on intercoastal port facilities and shipping lines and various inland waterways, and Federal aid for motor highway construction have formed the most important examples of direct Federal aid to transport agencies. During the 6 years 1933–38 the Federal Government expended more than a billion dollars on rivers and harbors; Federal highway expenditures during the 20-year period 1917–1937 totaled more than a billion and a half dollars. Construction of the canal probably helped industry in the Pacific States and the Atlantic Seaboard more than in other regions; southern coastal areas and districts along the Mississippi and Warrior waterway systems have probably benefited most from waterway expenditures; highway construction and betterment have been scattered throughout the nation and have tended to move industry from the greater urban centers to suburbs and smaller cities within metropolitan areas.

Another means whereby the Federal Government has affected areas' relative transport costs has been the regulation of common carriers, especially the railroads. Establishment of a milling-in-transit rate little higher than a through-haul rate is one illustration of this type of Federal influence. Establishment of such a rate has provided cities situated between purchase and sales markets a better opportunity for industrial development.[9] Regulation of the general level of rates undoubtedly also has been important; discussion of this, however, would lead to the historic controversy over territorial rate discrimination, which is too involved a question to be treated here.

One indirect means through which the Government has affected relative transportation costs has been its public land policy. The nineteenth century policy of selling land cheaply and granting homesteads in the West led to increased settlement and a greater volume of traffic, which in turn led to falling costs and thus to lower rates in that region.

Capital Costs

The Federal Government has affected the relative heights of regional costs both through its general monetary and banking policies and through its various credit agencies.

The centralization and mobilization of banking reserves through the Federal Reserve System has probably served to narrow regional interest rate differentials. Perhaps opposite in its effects has been Federal discouragement of State bank notes, through the imposition of a prohibitively high tax. This may at times have served to increase such differentials. Southern and western States have constantly complained of a shortage of capital, and especially during the period when those States were only poorly developed, new issues of bank notes might frequently have represented net additions to working capital instead of merely an inflation of the currency.[10]

Income Relationships Among Areas

Almost any act of Government may have some effect upon the relative heights of areas' incomes and thus many influence the location of consuming markets (hence also the location of industry). However, a few types of policies affect areas' incomes quite directly and thus merit special attention.

Revenues and Expenditures

One such policy is that with regard to revenues and expenditures. Obviously, the more the Federal Government depends upon steep rates of taxation on the upper income brackets, the greater the percentage of Federal revenues that will be contributed by the States with high per capita incomes. The more the Federal Government depends on tobacco, gasoline, and similar taxes, the smaller the percentage of Federal revenues that will be contributed by such States. Likewise, the greater the volume of Federal expenditures within a State, the greater the income of that State (and vice versa).

[9] See ch. 9.

[10] This, of course, involves the controversial theory which is discussed from a somewhat different standpoint in Keynes' *General Theory of Money, Interest, and Employment.*

Unfortunately, the precise balance of income which States pay to or receive from the Federal Government cannot be established; the incidence of many taxes and of many types of expenditures is unknown. However, the available data can be used for a rough picture of the situation.

The Social Security Board estimates that in 1937 the Federal tax burden[11] and Federal aid expenditures[12] (which constituted 43 percent of total Federal expenditures) were distributed as follows among the regions:[13]

Region	Percent of tax burden	Percent of Federal aid expenditures
New England	9	6
Middle Atlantic	32	21
East North Central	22	19
West North Central	8	15
South Atlantic	9	9
East South Central	3	6
West South Central	6	10
Mountain	3	6
Pacific	9	8

Of the Federal expenditures not included in the above, the most important are those on national defense, legislative, judicial, and civil establishments, payments to veterans, and interest on the national debt. Payments to veterans are distributed largely in accordance with the population. Expenditures on legislative, judicial, and civil establishments are no doubt concentrated largely in the District of Columbia and scattered more or less in proportion to population in the other areas. Expenditures on national defense are greatest in shipbuilding and aircraft districts and areas of heavy industry. Interest payments, which are in a somewhat different category from the other expenditures, are probably chiefly concentrated in the areas where high incomes are most frequent and banks' investment capacities have been greatest.

The logical conclusion to be drawn from these data on revenues and expenditures is that, at least if interest payments are excluded from the calculations (and perhaps if they are not excluded), Federal revenues from the Northeast[14] were proportionately greater than Federal expenditures in that region in 1937. The reverse was true of revenues from and expeditures in the South, the West North Central States, and the Rocky Mountain area. The Pacific States contributed and received approximately equal percentages of Federal funds. Data for other recent years lead to the same tentative conclusion.

This situation, of course, is largely the result of the recent importance of income taxes. In the nineteenth century, when Federal revenue was largely derived from customs duties (and when payments to veterans were chiefly distributed in the Northern States) the distribution of revenues and expenditures was probably more favorable to the Northeast.

Other Means of Altering Relative Heights of Areas' Incomes

In addition to fiscal policy, various types of Federal price regulation also importantly affect the relative heights of areas' incomes. Of those the following might be mentioned:

(1) Protective tariffs and reciprocal trade agreements;

(2) Price-pegging through crop loans, and crop control;

(3) The general regulation of prices through the antitrust acts.

During the greater part of tariff history, most of the favored parties have been manufacturers of the Northeast. Until recently the nation has been a net exporter of its important agricultural products; hence a protective tariff on farm-produced goods would have had little or no effect. However, with the expansion of manufacturing into the South and West and the change in the import-export position of certain American agricultural industries, recent tariff policy has distributed its benefits and its burdens more evenly over the country. The western beef and the southern textile are only two examples of important industries outside the Northeast which have been favored more recently by import duties.

Measures to improve prices of farm products, such as the Department of Agriculture's marketing orders

[11] The estimates are computed from summary table VIII, p. I–66, *Fiscal Capacity of the States*, Social Security Board, 1940. In a footnote to this table the estimates are described as follows: "Preliminary estimates of principal Federal taxes borne by residents of States and liquidated out of their current income payments. Estimates are based on receipts under more than 50 Federal tax levies, most of which are enumerated in text. Not all Federal taxes are included, because the accruals against which some are assessed—notably gifts and bequests—are disregarded in the estimates of income payments. These figures do not represent the amount of internal revenue collections in the various States, since some of the taxes, initially paid to the Federal Government by taxpayers in any given State, are assumed to have been shifted to the inhabitants of other States. * * * Estimates are still in an experimental stage and subject to revision."

A more complete explanation is given on page I–48. Because of the purpose for which the estnmates were made, social insurance and carrier pay-roll taxes upon employers, gift and estate taxes, and corporation income, capital stock, excess profits, and unjust enrichment taxes are excluded. Excise taxes and customs duties are allocated in accordance with estimated consumption of the taxed goods or services.

[12] Estimates are from Summary Table VI–A, p. I–61, *Fiscal Capacity of the States*. A breakdown of the estimates is provided in *ibid.* table 6 of each State series. The estimates are described as including "direct payments to States under cooperative arrangements and expenditures within States which provided direct relief, work relief, and other aid, exclusive of loans."

[13] Data for earlier years (1929–1937) are to be found in *ibid.* tables 6 and 8 of each State series.

[14] Defined as the area east of the Mississippi and north of the Ohio and Potomac Rivers.

and Commodity Credit Corporation loans and AAA crop control have chiefly favored the farm belts of the South and Middle West.[15] Among the products whose price has been "stabilized" are cotton, tobacco, wheat, hogs, and potatoes. The Department of Agriculture estimates that the ratio of prices received to prices paid, as based on the 1909–14 average, stood at 61 in 1932 and 93 in 1936–37. Not all this increase, of course, was due to loans and crop control, but the effects of Federal farm policy were undoubtedly quite significant. It might be added that Federal policy has also aimed at "stabilizing" the prices of bituminous coal and petroleum at a "sufficiently" high level. The Bituminous Coal Division of the Department of Interior fixes minimum prices for the former commodity; under the Connally Act, the Petroleum Conservation Division cooperates with State restrictions on petroleum output by guarding against interstate shipments of contraband oil.

Governmental policy may be said to have affected the prices of a vast number of products and the incomes of all areas through the activities of the Federal Trade Commission and the antitrust division of the Department of Justice. Among industries in which monopolistic and other "unfair trade practices" have been enjoined under the antitrust laws are sugar refining, petroleum, tobacco, meat packing, motion picture, glass bottle, and agricultural machinery. From one viewpoint, to the extent that Federal action has resulted in a greater degree of price competition, the Government has altered income distribution in favor of the areas where monopolistic elements are least important, i. e., in favor of the agricultural areas, chiefly found in the South and the West. From the opposite viewpoint, to the extent that Federal agencies have overlooked restrictions on competition, the Government has approved an income redistribution in favor of the areas where monopolistic elements are chiefly found, i. e., the industrial Northeast.

The War Industries Board of 1918, the National Recovery Administration, and the Office of Price Administration have also affected the distribution of income through price rulings which, however temporary, have often had immediate and profound effects.

Considerably more important has been the encouragement which the Federal Government gave to western land settlement. Rapid agricultural settlement resulting from the granting of homesteads and the sale of land at low prices greatly increased income per square mile in the western areas. In more recent years reclamation projects and the TVA have had similar results on a smaller scale.

Obviously, governmental influences upon the relative heights of areas' incomes will affect the location of consumer-oriented [16] industries most. In general, effects upon manufacturing are not apt to be nearly so important as those upon the service industries. Also, obviously, many of the means whereby the Federal Government affects the relative heights of areas' incomes will affect industrial location in other ways more importantly than through the effects upon the location of consuming markets. An example of such a means is a protective tariff.

Means Which Help or Hinder Certain Industries

Protective Tariffs

Perhaps the most important governmental influence on industrial location—certainly that of the longest standing—has been that exercised through tariff policy. The exact locational effects are, of course, impossible to determine; there are involved the old controversial questions of whether tariff protection increases total employment, whether it eventually lowers costs by enabling infant industries to develop, etc. (In the case of infant industries, protective tariffs may merely change the speed, not the location of industrial development.) However, certain general locational effects have necessarily been experienced.

While an import duty does not directly alter cost relationships among areas in the protected industry, it importantly affects their price-cost relationships for industry as a whole. Not all areas are in an equally favorable position to profit from a given import duty, and similarly not all areas are equally hurt by the unfavorable effects of protective tariffs upon exporting industries. In other words, protective tariffs enable the protected import industries to move into areas where they could not exist if free trade prevailed; and they cause at least some export industries to contract in areas where costs are high or production is undertaken largely for export. In addition, through the various forces of linkage,[17] such encouragement or discouragement of industry may have cumulative effects. Related industries may be encouraged or discouraged; and as has been stated above, the importance of an area as a consuming market may be helped or hurt.

[15] The A. A. A. program raised farm incomes in two separate ways: By raising crop prices and by giving farmers a direct "benefit payment." The latter has already been considered: such payments are among governmental expenditures and hence are covered by the above tables. Only the income effect achieved through price movements is considered here.

[16] See above, ch. 3.

[17] See above, ch. 5 for a discussion of the locational effects of industrial linkage. Among the forces of linkage are the provisions of a sales market, the provision of a purchase market, the training of labor and management, and the attraction of various service industries needed by manufacturing.

At least until a few decades ago tariffs caused industrial expansion chiefly in the Northeast; the export-determining effects of tariffs were experienced chiefly by extractive industries in the South and West. Among important tariff-protected industries in the Northeast were textiles, clothing, and steel; among important American industries largely dependent on foreign markets were southern cotton and tobacco and western wheat farming. It is probable that cumulative locational effects were experienced, even if the tariff served chiefly to speed development of infant industry areas. Because of differences in enterprise, social and economic customs, and the burdens of the Civil War and Reconstruction, southern infant-industry areas were not developed along with those to the North, and in the North the tariff-aided industries helped to develop others.

As has been pointed out above, however, in more recent years other areas as well as the Northeast have experienced tariff-aided industrial development. Examples are the Southern Piedmont with its cotton textiles, New Orleans with its sugar refining, and the Kansas City-Omaha area with its meat packing. In recent years the automobile and machinery industries have been added to those with a net export balance, and therefore probably to those which would have had greater foreign sales if the United States had bought more foreign goods. Cumulative locational effects have probably also been experienced; but since the Nation is far more mature industrially than during the nineteenth century, it is doubtful that the cumulative effects of the later developments have been nearly as important as the earlier.

Excise Taxes

Like import duties, excise taxes tend to raise prices. Unlike import duties, they do not improve the competitive position of domestic producers in the domestic market. Thus their net effect (if other than merely a slight narrowing of the profit margin) is contraction of both consumption and production. The extent of contraction depends upon the height of the tax relative to the value of the product, the mobility of the factors involved in producing the goods concerned, and the elasticity of demand for the taxed goods or service (which depends in large part upon the price and quality of possible substitutes, if such substitutes exist). The locational effect of the tax depends upon the extent of contraction, the comparative costs of various existing or potential producing areas, and the costs of producing substitutes in various areas.

Leading excise taxes at the present are those upon gasoline, tobacco, alcoholic beverages, colored oleomargarine, and various miscellaneous luxuries (toilet preparations, firearms, sporting goods, cameras, lenses, admissions, etc.). The rates on tobacco, alcoholic beverages, and colored oleomargarine are quite high; rates on the miscellaneous luxury products are sometimes high and sometimes low.[18] It is doubtful that the consumption of many of the products is substantially curtailed by the present taxes.[19] Probably the chief locational effects are the encouragement of butter production in the dairying areas and the discouragement of margarine manufacturing in the areas producing cottonseed oil or other oils suitable for margarine production.

Federal Expenditures

Federal expenditures affect the geographical distribution of industry not only by affecting the relative heights of areas' incomes, but also by providing a stimulus for certain types of industries:

(1) Industries selling directly to the Government (such as the shipbuilding);

(2) Industries supplying the above (such as the iron and steel);

(3) Industries producing goods for which the demand is indirectly increased through Federal expenditures (such as the automobile).

During the armament program many of the locational effects of Federal expenditures have been planned; this has been especially true where Federal funds have been used to finance the construction of new plants. An important part of the program has consisted of the placing of munitions and other plants in areas characterized by severe unemployment (whether of an obvious or disguised nature); industrial employment in predominantly agricultural areas has increased greatly as a result of these projects, especially in southeastern districts suitable for shipbuilding operations. However, even armament contracts are given mainly to firms operating already existing plants, and of necessity have been concerned more with military requirements than with any broad purpose such as diversification and decentralization.[20]

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[18] The following are a few of the excise tax rates: Large cigarettes, \$7.20 per 1,000; small cigarettes, \$3 per 1,000; fermented malt liquors, \$6 per 31 gallons; distilled spirits, \$3 per gallon; gasoline, \$0.015 per gallon; radios and phonographs, 5.5 percent; sporting goods, 11 percent; firearms, 11 percent; toilet preparations, 11 percent; colored oleomargarine, \$0.10 per pound.

[19] Of course, even when total consumption does not seem to be affected, there may be a "qualitative effect" which influences location; i. e., a cheaper instead of a more expensive brand may be bought, and the two brands may be produced in different areas. Moreover, if there is neither a quantitative nor a qualitative change in consumption of the taxed article, increased expenditures on the taxed article will cause decreased consumption of other goods. This may have a locational effect.

[20] This is not meant to imply that all placing of contracts with existing firms has been in accord with military requirements, or that less crowding in certain centers might not have resulted in greater efficiency for military purposes.

In more nearly "normal" periods Federal expenditures have rarely been associated with industrial planning, except as certain purchases have resulted from pressure brought to bear by local-interest groups. The construction industry is probably affected directly more than others by governmental nonmilitary expenditures, because of the scope of the Federal highway and public works programs.[21]

State and Local Influences

Neither all the planned nor all the unplanned types of governmental influence upon the location of industry are those exercised by the Federal Government. Both State and local governments have created planning and promotional agencies and both have altered the relationships among areas' cost levels. Local nongovernmental agencies have likewise influenced relative costs. In addition, through the use of their power to tax and to regulate the use of their highways, State governments have sometimes erected interstate trade barriers.

State Influences

At the present time State action directed toward influencing industrial location consists largely of fact-finding and fact-disseminating, i. e., of industrial surveys and informational services. Surveys commonly include reports on State resources and other industrial advantages. Some include also an inventory of the types and quantities of idle capacity within the State. During the war program, State planning boards have been using such inventories in order to facilitate subcontracting and the pooling of several firms' capacity for taking a single direct contract. State informational functions sometimes consist chiefly of the publication of bulletins which are supplied those businessmen who request information concerning investment opportunities. Most States, however, advertise in national publications, and some add field officers to their central informational staff. The success of State advertising and other informational efforts probably varies widely; some States pronounce themselves well satisfied with the results achieved, although in general, experience seems to cast doubt upon the effectiveness of such advertising as a means of influencing industrial location.

In 1939, 23 State governments, 21 of which were in the South and East, supplemented fact-finding and fact-disseminating with special tax concessions.[22] In these States commissions had the power to examine firms requesting such concessions and to decide which should be thus favored. The Mississippi Industrial Commission went further and supervised municipal promotional efforts, deciding whether or not to allow a municipality to subsidize new plants with public funds.

Two types of industrial promotion have been provided for in State laws. One provides for publicity only, while the other type involves active and aggressive promotion either by the State or by local communities.

State agencies established to handle advertising to attract industry have included:

Connecticut Development Commission.

Kentucky Progress Commission.

Maine Development Commission.

Massachusetts Industrial and Development Commission.

New Jersey Council.

North Carolina Department of Conservation and Development.

Vermont Department of Conservation and Development.

Washington State Progress Commission.

Wyoming Department of Commerce and Industry.

Indiana Division of Publicity.

Illinois Development Council.

Kansas Industrial Development Bureau.

Pennsylvania Department of Commerce.

New Hampshire Planning and Development Commission.

New England Council and Southern Governors Council, regional organizations.

State agencies responsible for actively inducing the location of industry within their States have included:

Alabama Industrial Authority.

Arkansas Agricultural and Industrial Commission.

Louisiana State Board of Commerce and Industry.

Mississippi Industrial Commission.

North Carolina Department of Conservation and Industry.

South Carolina Board of Promotion of External Trade.

In addition, 43 States (all except Maine, Delaware, Ohio, Texas, and Iowa) have created planning boards, which carry on research activities, but usually do not have directly promotional functions.

Most of the State agencies confining their activities to advertising have as one of their objectives the attraction of tourists. However, all those listed here have among their aims the attraction of industry. Such organizations have operated either as direct promotional agencies themselves, or as regulatory bodies to administer local plans established under State laws.

[21] See ch. 9. In 1939 more than a billion dollars was spent upon the various Federal public works projects. However, a quarter of this amount was expended upon reclamation, rivers and harbors, and flood control.

[22] Source: *Business Week*, October 9, 1939; Summary of release by Public Administration Clearing House, Chicago.

The Mississippi plan, "Balance Agriculture with Industry," operated from 1936 to 1940, when the law was repealed. Under this plan, which called for State supervision of local promotional efforts, it is claimed that 10 new establishments were attracted to the State. Four thousand workers were employed in these establishments, which were partly financed by bond issues amounting to $760,000. Other bond issues were approved by communities in which negotiations failed. The principal criticism of the plan was that it attracted substandard industries. Supporters of the plan claimed that it kept fly-by-night concerns out of the State.

In Arkansas, the Agricultural and Industrial Commission cooperates with municipalities in acquiring land and buildings to attract industries. The North Carolina and South Carolina agencies are not known to have financed any concerns, but their purpose appears to be direct promotion as well as advertising. This is also true of the Alabama Industrial Authority.

Other ways in which State governments have influenced the relative heights of areas' costs have been through their general tax policies (as opposed to special concessions), regulation of public utility rates, labor policies, and development of transport facilities. In the last century canal and railway subsidies were quite important; in this century highway expenditures have played a leading role. Of costs thus affected, transport costs have probably been the more significant for industrial location; tax differentials have not usually loomed large enough to upset relationships among States.[23]

States have erected interstate trade barriers when they have:

(1) Levied special taxes on out-of-state goods but not on locally produced competitive goods (as a tax on margarine unaccompanied by a similar tax on butter);

(2) Given preference to local producers when State contracts have been awarded;

(3) Applied embargoes upon such articles as citrus fruit and alcoholic liquors;

(4) Regulated the use of highways so as to discourage the entrance of out-of-state trucks.

Local Influences

In the case of local governments, it is often difficult to distinguish between the influence of municipalities themselves and the influence of citizens' associations such as the Chamber of Commerce. Both have advertised and offered special concessions in order to develop industry within their localities. Perhaps the chief difference is that the citizens' associations have per se lacked the power to grant tax exemption.

Among the special concessions which citizens' associations have offered have been gifts of cash, of property, and of services, loans and stock subscriptions, and "promises" of labor "loyalty." Local governments have added tax exemption to this list.

Survivors among the many inducement funds established prior to 1930[24] attest to the fact that in some instances facilities for advancing financial aid have been successful enough to be continued. And while the consensus now is that assistance should be confined to services helpful in the selection of plant location, the competition between communities is so intense that, when confronted with an imminent problem of attracting industry, many communities are still willing to make a financal contribution. To the extent that the smaller communities are more willing to offer inducements of this nature than the larger cities, financial inducements have had a decentralizing influence.

Evidence does not indicate that local financial inducements have had a net effect on the regional distribution of industry. The willingness with which communities in all regions have made efforts to attract new establishments indicates that the competition has been largely between localities within regions.

In several States municipal organizations have been authorized to function as official or semiofficial bodies to induce factories to be located in their communities. Some such organizations have functioned in connection with State commissions; examples have been those in Mississippi, Arkansas, and New Jersey. Other organizations of a similar nature have operated independently of State agencies.

As has been stated above, many of the municipal organizations concerned with the attraction of industries have been of only a quasi-governmental nature, i. e., they have consisted of such citizens' associations as chambers of commerce. A partial list of community advertising organizations and community industrial financing plans follows:

COMMUNITY INDUSTRIAL FINANCING PLANS

[Miscellaneous and defunct plans reported by Chamber of Commerce.]

Cape Girardeau, Mo., public solicitation.

Waukesha, Wis., Factory Building Corporation organized in 1928, now defunct.

Benton Harbor, Mich., small revolving fund used to pay moving expenses or to furnish free land.

Claremont, N. H., aid to two concerns.

[23] Data published in table C-1 of the Twentieth Century Fund report, *Studies in Current Tax Problems*, New York, 1937, show that assessed values are usually well below actual values. State tax rates on assessed value seldom exceed 1 percent. Income tax differentials are probably somewhat more significant; in some States the rate on net incomes of $10,000 derived from corporations is as high as 6 or 7 percent. State income taxes, however, constitute only a small percentage of total value of product.

[24] See table 1.

Schenectady, N. Y., industrial credit fund of $300,000 never used. Small industrial fund used for promotion.

Oklahoma City, Okla., assistance in private financing.

Syracuse, N. Y., credit fund dissolved.

Fort Wayne, Ind., Greater Fort Wayne Development Corporation, now owns buildings and land purchased at the time of organization. No financing.

Portland, Ore., fund plan dissolved after three capital losses.

Toledo, Ohio, community industrial guarantee fund of $1,000,000. Never used. Dissolved.

Lowell, Mass., industrial revolving fund dissolved after 3 years.

Lock Haven, Pa., plan abandoned.

Johnstown, Pa., board of industry of chamber of commerce loans on basis of pay-roll expenditures.

Glasgow, Ky., public solicitation for clothing factory given rent free.

Kankakee, Ill., expenditures for services in connection with locating new industries.

"Unplanned" ways in which local governments have influenced industrial location have been through their general tax policy (as distinguished from special tax concessions), through their labor policy (as reflected in the attitudes of the police), and through development of such transport facilities as docks and warehouses.

Promotion by Public Utilities

In connection with private efforts to influence the location of industry, the efforts of public utilities should be mentioned. It is probable that no direct material assistance can be offered by public utilities because of legal restrictions. However, advertising by utilities connotes a willingness on their part to offer services incident to the establishment of new factories.

Railroads also have maintained industrial agents for the purpose of promoting the establishment of industries along their right-of-way. Rate concessions have been offered, and detailed surveys of prospective plant sites have been made. Efforts have been extended from obtaining new plants to promoting existing small plants along the road as subcontractors.

TABLE 1.—*A partial list of community industrial financing agencies*

[Compiled by the Community Organization Division of the U. S. Chamber of Commerce]

	Year organized	Fund	Industries aided
La Crosse, Wis., Industrial Association	1910	$100,000	50
Easton, Pa., Guaranty Fund (joint endorsement)	1910	1,000,000	25
Scranton, Pa., Industrial Development Co., Inc.	1914	----------	9
Baltimore, Md., The Industrial Corporation of Baltimore City	1915	200,000	-------
Louisville, Ky., Industrial Foundation	1916	876,000	40
Hoquiam, Wash., Industrial Revolving Fund	1923	4,000	3
Muskegon, Mich., Greater Muskegon Industrial Foundation	1925	270,000	11
Hopkinsville, Ky., Industrial Foundation	1926	137,000	-------
Wheeling, W. Va., Ohio Valley Industrial Corporation	1926	1,200,000	8
Rochester, N. Y., Industrial Development Corporation	1927	305,000	9
Omaha, Nebr., Industrial Development Corporation	1927	60,000	16
Akron, Ohio, Industrial Foundation	1928	75,000	8
Tulsa, Okla., Industrial Corporation	1929	750,000	20
Danville, Ill., Industrial Foundation	1930	100,000	7
Elmira, N. Y., Industries, Inc.	1934	300,000	9
Grand Rapids, Mich., Industrial Corporation	1935	50,000	1
Little Rock, Ark., Industrial Foundation	1936	100,000	5
Portland, Maine, Council for Industrial Progress	1935	----------	4
Wilkes-Barre, Pa., Wyoming Valley Industrial Development Fund	1937	----------	-------
New Bedford, Mass., Industrial Development Legion	1938	52,000	-------
Brockton, Mass., Industrial Fund	1938	40,000	-------
Adrian, Mich., Chamber of Commerce	1938	----------	-------
Zanesville, Ohio, Industrial Foundation	1936	----------	2
Lima, Ohio, Chamber of Commerce	----------	[1] 72,000	2
Elkhart, Ind., Chamber of Commerce	1926	[1] 165,000	-------
Vicksburg, Miss., Chamber of Commerce	1935	90,000	1
Binghamton, N. Y., Binghamton Industrial Financing Fund	----------	475,000	1
Pittsfield, Mass., Industrial Development Corporation	1919	100,000	-------
Elgin, Ill., Chamber of Commerce	1937	[1] 25,000	1

[1] Grants.

CHAPTER 20. THE SELECTION OF LOCATIONS

By Edgar M. Hoover, Jr., and Charles P. Wood*

Preceding chapters have described the geographic pattern of the American economy and have analyzed in some detail the principal determining factors. Certain logical gaps remain, however, to be filled.

First, it will be necessary to examine more closely the process of "industrial migration." Locational shifts being the direct result of decisions by businessmen, it is important to appreciate the types of decision involved and how they add up to a change in the pattern.

Secondly, attention will be given to the choice of location for particular plants. In some cases a single factor is all-important, but more generally the "ideal" location represents a compromise. Access to market, labor cost, and the other considerations have to be given their proper weights in comparing the advantages of different locations. Methods currently used in evaluation of locational factors and selection of sites will be critically discussed.

Finally, some attention will be given to ways in which public agencies may help in the selection of good locations.

Types of Changes in Locational Patterns

It is so usual to refer to "migrations of industry" that one is likely to think of these as analogous to the migration of persons. Actually, however, most of the change in the geographic pattern of production occurs not through the transference of existing establishments from one site to another but in various other ways.

A shift in the geographic distribution of an industry must involve increased activity in some areas or decreased activity in others, or perhaps both. When a single firm operates in more than one area, the transfer of activity is more subject to plan: that is, an increase in one location and a decrease in another may both be part of the same decision.

Production can be increased at any given location by:

1. More intensive utilization of existing capacity (i. e., equipment and labor).
2. Conversion of capacity from other industries to the one in question.
3. Construction of new capacity, either as additions to existing plants or as new plants.
4. Bringing in equipment and labor from other locations.

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Any of these steps may be taken by existing firms or may involve setting up new firms.

Inversely, production can be curtailed at any given location by reduced utilization of capacity, by conversion to other uses, by partial or complete demolition, or by removal to other locations. These steps may be taken by firms which continue to exist, or may involve the disappearance of firms.

Any form of expansion of production at one location, accompanied by a different degree of expansion or by contraction elsewhere, leads to a shift in the geographic pattern of an industry. There is obviously a large variety of possible combinations. Moreover, for some purposes it is appropriate to distinguish between shifts that involve just one firm (e. g., reallocation of output among branches) and shifts involving more than one firm.

In the very short run, changes in the degree of utilization of existing capacity predominate. But in the more significant trends of industrial location, decisions involving construction, abandonment, conversion, or transference of productive capacity play the leading part.

In some fields it is easier to change products than to change location; the enterprise is fairly well rooted to one spot but can exercise some choice in conversion. The prime example of this practice can be found in agriculture, where farmers seek not so much the best location for a specific crop as the best crop for a specific location. Here instead of the question of "location," we refer more often to that of "land utilization," which is the same thing viewed from a different angle.

In manufacturing industry, to which this report devotes special attention for reasons already set forth, there are likewise alternative uses for a site owned by a particular firm. But equipment is more specialized than in agriculture, and enterprise more mobile; so the manufacturer usually thinks in terms of finding a location for a particular line of production to which he feels committed. Large firms are in a position to canvass the possibilities on a nation-wide scale; the moves of smaller firms are usually confined within a region.

Outright relocation of establishments is relatively uncommon. Most of the change in the industrial location pattern is brought about by the establishment of new plants and the liquidation of old ones; just as in a region with a relatively immobile population, most changes in the distribution of population are the result

of birth and death rate differentials rather than migration.

Daniel B. Creamer found that relocated plants reported in a 2-year intercensal period accounted for about one-third of 1 percent of total manufacturing wage earners. He concluded that even "if all changes had been in one direction, the alteration of the locational pattern [due to relocation] would scarcely have been noticeable." [1]

This "relocation rate" of about one-third of 1 percent per biennium should be compared with "birth rates" and "death rates" of 3 to 5 percent for industrial establishments in semidurable industries during the same period.[2] In the durable-goods industries the turn-over of establishments is naturally slower, but "births" and "deaths" still far overshadow relocations.[3]

Corroborative evidence on the relative importance of new plants and liquidations in redistribution, as against actual relocations, is found in table 1. Much more detail is provided in a joint report on industrial location by the Bureau of the Census and the Bureau of Agricultural Economics.[3a]

Even the direction of net locational change is different from the direction of plant transference. A disproportionate share of the new plants are established in large industrial cities, but most of the relocations are toward suburbs or smaller towns.[4] Apparently the cities serve to some extent as germinating grounds for new enterprises which frequently move out after getting a start.[5] Creamer says:[6]

> In view of the abundant evidence of an ever decreasing share of wage jobs located in the principal cities, it is of interest that the highest birth rates * * * have been in the principal cities. On the other hand, despite the relative growth in manufacturing importance of the industrial peripheries, these communities have a relatively low birth rate. The data on relocated establishments suggest that the periphery towns have grown chiefly by the immigration of manufacturing plants and their expansion subsequent to relocation.

TABLE 1.—*Analysis of gains and losses of industrial plants reported in 1,934 cities in the United States, 1926–27*

	Plants	Employees	Average number of employees per plant
Total gains	10, 267	371, 334	36
New plants	8, 400	209, 460	25
Branches	903	92, 842	103
Relocations	964	69, 032	72
Total losses [1]	5, 903	203, 905	35
Out of business [2]	4, 861	132, 105	27
Relocations [3]	1, 042	71, 800	69

Source: *Industrial Development in the United States and Canada*, a cooperative survey by the Civic Development Committee of the National Electric Light Association and the Policyholders Service Bureau of the Metropolitan Life Insurance Co. New York, 1928(?), pp. 8-11.

[1] Data on losses are probably incomplete.
[2] Includes branches closed.
[3] Includes branches moved away.

It appears then that the major active part in locational change is played by executives' decisions as to the location of new plants. Abandonments of plants are almost equally important statistically but are certainly less a matter of choice. Direct relocations of plants, and conversion of plants from one industry to another, are important only under exceptional circumstances, as in some stages of industrial mobilization for war.

In the absence of specific information it may be presumed that branch plants are more readily adapted to the various forms of locational shift than are independent plants of comparable size in the same industry. For one thing, the branch plant belongs to a large organization with the resources and contacts required for making fairly elaborate studies of location. Probably a more important factor is that a branch-plant concern can close one branch and open another, or reallocate specialized lines of production among its branches, without necessarily disrupting its market relations. Its customers may not know or care which branch actually makes the product they buy. In contrast, a shift of production between two plants in different firms involves costly making and breaking of market connections.

Location Factors

The important factors determining the most economical location for an industrial plant have been discussed individually in earlier chapters, and may be summarized as follows:

1. Factors directly dependent upon transportation.
   a. Access to sources of materials (including fuels).
   b. Access to markets.
2. Factors not directly dependent upon transportation.
   a. Labor costs.
   b. Rents.
   c. Taxes, subsidies, etc.

[1] Carter Goodrich et al., *Migration and Economic Opportunity*, Philadelphia, University of Pennsylvania Press, 1936, p. 340.

[2] *Ibid.*, table 47, p. 332. The "birth rate" is the number of wage earners in plants established since the previous biennial Census, expressed as a percentage of total wage earners in the same industries. The "death rate" is similarly calculated on the basis of plants which went out of existence since the previous Census.

[3] *Ibid.*, table 45, p. 330.

[3a] Harold D. Kube and Ralph H. Danhof, *Changes in Distribution of Manufacturing Wage Earners 1899–1939*, 1942.

[4] During the period 1927–33, comparison of biennial Census reports showed a net relocation of 21,717 industrial wage jobs out of principal cities and satellite cities of industrial areas. Peripheral territory in industrial areas received 13,168 of these. Goodrich and others, *op. cit.*, table 50, p. 340.

[5] Locational shifts within the Chicago area between 1920 and 1930 offer an example. Manufacturing establishments in the city of Chicago became more numerous at the same time that the near suburbs were growing in relative industrial importance. Over half the factories established in the suburbs during the period 1926–31 had emigrated from the city. William N. Mitchell, *Trends in Industrial Location in the Chicago Region since 1920*, University of Chicago, 1933, table VIII, p. 49; and table XIII, p. 62.

[6] Goodrich and others, *op. cit.*, p. 334.

d. Interest.

e. Expenses and availability of management and supervision.

f. Risk, depreciation, etc.

This classification emphasizes the cleavage between those locational factors in which transportation is an essential element and those in which it is not. The first group involves costs of physical transference of materials or products, the effect varying directly with the structure of transport rates. Locational advantage can be expressed roughly in terms of distance from specific points.[7] In the second group, on the other hand, the influence of transport costs appears only indirectly, if at all, since the resources must be used where found.[8]

The factors of size and scope, also discussed in earlier chapters, always exert their influence through one or more of the cost items outlined above. Thus the advantages of a large plant or a diversified production center are manifested in lower labor costs, overhead, or other items; and the chief limitation upon geographical concentration of production appears in the transport cost items.

Techniques for Measurement of Relative Importance of Factors

After the enumeration of the various requirements influencing the location of plants in a particular industry, the obvious and usual next step is an attempt to measure their relative importance. It is realized in advance that no single location is ideal from all standpoints, and that consequently some compromise must be made among the objectives of minimizing materials cost, labor cost, marketing cost, and other items. A formula for the best location from an all-round standpoint would require that each factor be assigned its proper weight.

The attempt to measure the relative importance of locational requirements for plants of a given industry is not new. In fact, almost any discussion of the economics or the history of an industry is likely to contain some statement as to which considerations were apparently dominant in determining its geographic distribution. The techniques involved in arriving at such judgments, however, are often faulty and apt to mislead. It will be shown that the relative locational importance of the various locational factors cannot be given accurately for an industry as a whole. Since this limitation is not generally realized, it is appropriate to consider critically a few of the systems of factor-evaluation actually employed in locational analysis.

One method, commonly applied by outside investigators rather than by firms actually seeking a location, is that of "apparent association." The analyst examines the characteristic habitat of the industry in question, notes its chief features, and points to them as dominant locational influences. For instance, if a certain type of chemical industry is usually found in the immediate proximity of oil refineries one might conclude without knowing anything further about the industry that nearness to oil refineries was the dominant locational requirement. The risks and limitations of such a method are evident, however, even where it can be made to yield a definite and plausible statement. In most cases, the real reasons for location cannot safely be deduced merely from the facts of distribution. Some further insight into the actual character of the industry in question is necessary.

A somewhat more penetrating method also favored in "external" investigation is that of questionnaires to the firms in the industry, asking which requirements they deem most important in determining desirability of location.[9] This method is also subject to grave defects. In the first place, there is no clear

[7] The time consumed and the deterioration or risk involved in shipment are likewise important functions of distance. A fuller treatment is given in chs. 6, 9, and 10 above.

[8] This distinction, like many others, has its difficulties. For instance, labor cost would generally be regarded as a nontransport factor of location because it depends upon the relative supply of labor already present in different localities. But in some situations it would appear that transportation does help to determine the geographic pattern of labor costs. This will be true if a plant is to be located at some distance from the residence area of its prospective labor force, so that a fairly long commutation journey is necessary. It is likely then to be found that the difficulty of securing adequate labor supply increases directly with distance, and that the money and time cost of daily commutation thus enter into the locational reckoning. This may mean that the firm finds it necessary to supply transportation at a cost depending on the distance, or it may mean merely that greater distance from workers' homes necessitates higher wages, greater difficulty in obtaining temporary or substitute employees, more rapid labor turn-over, or other elements of increased labor costs.

A somewhat different case is that of the plant which plans on an actual migration of workers to the new location. The spread of many skilled-labor industries from New England to the West and South, for example, was made possible by the transference of "key men" to serve as a nucleus for a new labor force. The recent expansion of armament production into relatively unindustrialized areas follows a similar plan. In cases of plant relocation it is not unheard-of for a firm to offer to assist the migration of any of its old employees who care to follow. Here again, passenger transport costs enter into the reckoning of relative locational advantages. However, in this case, the transportation of labor is analogous not so much to the shipment of a raw material as to the shipment of durable machinery or equipment, and is to be regarded as an investment rather than a current expense. Theoretically at least, only the annual amortization accrual of such an investment should be set up alongside the various current elements of cost in determining the balance of locational advantages.

[9] This questionnaire approach has most often been directed toward the explanation of *shifts* in location. For instance, in 1928 the Metropolitan Life Insurance Co. and the National Electric Light Association collaborated in questioning manufacturers who had moved or set up new plants in 1926–27. An analysis of the results was published under the title, *Industrial Development in the United States and Canada.* More recently a New York State legislative committee (the Ives Committee) has been conducting a questionnaire survey on industrial relocations, new plants, and plants out of business in New York State, asking reasons in each case.

indication on such questionnaires as to the meaning of the term "importance." The present discussion shows the variety of possible interpretations of the term, which may be reflected in replies to questionnaires. Some respondents, for instance, may indicate as "most important" those items regarded as absolutely indispensable, like water supply, although by others these might be taken for granted and omitted altogether. Some may indicate the items which bulk largest in total cost, regardless of whether or not they can be influenced by a change of location. Some respondents will allude particularly to factors of importance for interregional choice of location (for instance, fuel costs), while others will stress factors like rent or taxes, which vary locationally within an entirely different and much smaller geographic range of reference. Finally, there is at least the possibility that some of the respondents will be particularly conscious of certain locational factors which they view with resentment (e.g., taxes), and may exaggerate their importance.

Another commonly-used method of gauging the relative importance of locational factors is to compute the relative magnitude of different items in the cost bill of the average plant in the industry. Thus, in analyzing the manufacture of cement, we can make the following tabulation from data in the 1939 Census of Manufactures:

Cost item	Total expenditure	Percentage of total value of product
Materials and supplies	$34, 034, 358	17. 7
Wages	31, 588, 404	16. 4
Fuel	24, 164, 457	12. 5
Purchased electricity	9, 908, 469	5. 1
Salaries	7, 408, 199	3. 8
Other items, including interest, legal and other professional services, taxes, profits, etc	85, 507, 417	44. 5
Value of products	192, 611, 304	100. 0

Such a tabulation as this can be very useful as a basis for provisional elimination of unimportant factors and for further analysis of important ones. However, it cannot stand by itself as a statement of relative weights of factors. To illustrate: we might conclude, from the figures given, that materials and supplies were rather more important than wages in determining location, and that electric power rates were considerably less than half as important as fuel prices. This would be misleading to say the least, since it implies that we have as equally available alternatives the saving of, say 1 percent on materials expenditure, or 1 percent on labor costs, or 1 percent on electric power charges. In actual fact, some of the expenditures may be highly variable according to location and others not, and it is impossible to say that one requirement is more important locationally than another until we take this into account. In the alcoholic-beverage and tobacco industries, for example, a major cost item is the Federal tax; yet so far as choice of location within the United States is concerned, its influence is absolutely nil.

Another defect of the break-down of product value is that it cannot be extended to cover the requirement of access to market. It would, of course, be absurd to take the entire value of the product as representing the weight of this requirement, since in that case the importance of market access would always be equal to the sum of all other requirements.

This suggests recourse to still another method of measurement, according to which the importance of the transport requirements, access to materials sources and access to markets, are gauged according to the amount spent in transportation and associated expenses, such as selling expenses. Thus, if an industry had a wage bill of $10,000,000, a freight bill of $5,000,000 on its materials, and selling expenses (including delivery expense on the product) of $15,000,000, the relative importance of labor costs, materials, and markets would be stated as 2, 1, and 3, respectively.

This last method would, of course, give quite different results from any of the previous ones—in fact, each of the methods which have been discussed gives a different answer. The most serious criticism of the last method is that it assumes that it is just as easy to relocate so as to reduce freight expenditures by a certain percentage on a commodity hauled 500 miles as to reduce freight expenditures by an equal percentage on a commodity hauled only 5 miles. It exaggerates the locational importance of transport costs on those materials which happen to be hauled long distances. Precisely those materials which are most important locationally are likely to be the ones on which plant location has been designed to save transportation. It may well happen, then, that the costs of transportation on the really dominant material (or product) show the least total expenditure, or none at all, simply because the plant has been so located as to minimize or eliminate that item.

Still another obstacle to the setting up of standard "weights" for the locational factors relevant to an industry is that of variability of production technique. Practically all processes can be varied so as to use less of those materials and services which are relatively expensive at a particular location, and to use more of the relatively cheap ones. An example from the chemical industry is presented at a later point in this chapter.

Thus in areas where oil, gas, or wood is cheap, one of these fuels may be substituted for coal. Where labor costs are high, mechanization is pushed further. High rents can be met, to some degree, by less extensive plant lay-outs. The disadvantage of scanty water supply at an otherwise advantageous locality may be met by the installation of special equipment to make possible the reutilization of water—in other words, equipment requirements can be substituted for some of the water requirements.

Quite commonly, such variations in production technique are associated with differences in the nature of the products, or with modifications of the product-combination. Thus, different systems of oil refining yield different proportions of the various final products; and in the making of footwear quite different degrees of mechanization, labor requirements, and organization in general are appropriate to the various kinds of staple and nonstaple shoes. Where these differences in the product are great, it may become difficult to say just how great a variety ought to be classed within the scope of a single industry, and a more or less arbitrary decision has to be made as to where one industry ends and another begins.

It is clear that the production requirements of an industry are not fixed. There is a whole array of possible combinations, depending upon the relative costs of various materials or services and the relative demands for different types of product. These in turn depend in large part upon the way in which production is organized: whether it is concentrated in a few large units or dispersed, and whether the units are specialized or diversified in character.

We must accept reluctantly the conclusion that no accurate statement of the relative importance of various locational factors for an industry or even an individual plant is possible. Fortunately, such a statement is not necessary for the rational location of individual plants, by practical methods described later in this section. Moreover, even the rough and qualified weightings of locational factors which the industry analyst can make are quite useful. In a particular case certain factors can be eliminated as of negligible importance (e. g., labor for electric power stations), and attention directed to the more significant items.

Classification of Industries According to Dominant Locational Factor

Many industries, too, can be conveniently pigeonholed according to dominant locational factor or factors, for example:

Costs of assembling materials.—Industries using heavy, bulky, or perishable materials and producing relatively light, compact, or nonperishable products; cement, smelting of metallic ores, clay products, cotton ginning and oil extraction, canning and preserving, and most grain-products industries.

Costs of fuel or electric energy.—Heat treating and many types of chemical and metallurgical operations, such as the making of aluminum, magnesium, caustic soda and chlorine, artificial abrasives, and alloys.

Costs of labor.—Textiles, garments, machine tools, and other industries requiring skill.

Costs of selling and delivery.—Products which are heavy, bulky, or perishable relative to the materials which must be transported to make them, including beverages, containers, most building materials, newspapers, direct services, and style goods of all kinds.

Each of the above categories of production suggests an approach directed to the dominant locational factor. Such a rough preliminary classification provides guidance to the business firm in its appraisal of locations, and also to the planning agency concerned with the needs of communities or regions and their industrial potentialities.[10]

A Choice of Location

Any judgment on locational policy must take account of the techniques by which individual firms actually select their sites. Only after consideration of these techniques can one approach the question of whether better location—from either a private or a social viewpoint—might be attained by judicious measures of public assistance or control.

It is sometimes alleged that private concerns are located at random or on a largely arbitrary basis according to the whim of the executive or his wife. Such relatively haphazard location is frequently found, and indeed there are some lines of business where the choice of location is rather immaterial from the private-interest standpoint at least. It is precisely these relatively "foot-loose" industries which may be most usefully and safely steered by public policy.

On the other hand, many firms (particularly large ones) have undertaken elaborate and expensive surveys before locating plants. The steel works at Gary are an outstanding example of such a planned location. Doubtless many more firms would make preliminary surveys if information were more readily available, and if techniques for using it were improved. Quite possibly, additional survey material and methods could be worked up by trade associations or public agencies more cheaply than by individual business firms, and considerable duplication of effort eliminated.

[10] Considerable material on the classification of industries according to dominant locational factor is given by the National Resources Committee, *The Structure of the American Economy*, Part I, June 1939, ch. IV and Appendices 8 and 16.

Moreover, the frequency of aimless and ill-informed individual locations tends to obscure an underlying tendency to rationality in the locational pattern as a whole. Competition, in so far as it prevails, rewards well-located enterprises and shortens the lives of the poorly located. Thus even if new enterprises were set down purely at random, the competitive "survival of the fittest" would still produce some semblance of a reasonable pattern.

Formulation of Production Requirements

The first step in locating a plant is to set forth its production requirements in quantitative terms. In view of the possibilities of substitution of materials and adaptation of processes to local conditions, the statement of requirements may be rather complex, involving several different possible combinations.

Such variability of technique is found even in chemical process industries where it might be thought that the necessary proportions of production factors would be rigid. For example, caustic soda is currently produced by two distinct processes, the electrolytic and the lime-soda. The equipment required is altogether different, and the materials used are as follows:[11]

Electrolytic process

Requirements:		
Salt	tons	1.7
Sodium carbonate (58%)	do	0.025
Sulfuric acid (66° Bé.)	do	0.100
Steam	do	10
Refrigeration (ice equivalent)	do	0.9
Electricity	kwh	2,500
Direct labor	man-hours	18
Products:		
Caustic soda (76%)	ton	1
Chlorine	do	0.875
Hydrogen	cu. ft.	8,750

Lime-soda process

Requirements:		
Soda ash (58%)	tons	1.45
Lime makeup (90% CaO)	do	0.08
Water	do	9
Steam	do	1.35
Reburning fuel	B. t. u.	13,000,000
Electricity	kwh.	18
Direct labor	man-hours	18
Products:		
Caustic soda (in 11% solution)	ton	1

In the above case either of the two processes may be preferred to the other on the basis of the relative availability of materials, fuel, and power and demand for products. In an area with cheap electric power, good access to sources of salt, and close to a market for chlorine, the basis of site selection would probably be the requirements of the electrolytic process—in certain other areas the requirements of the lime-soda process would govern.

Geographic Variations in Costs

When the material and service requirements have been set up, with such flexible qualifications as may be appropriate, the logical next step in selecting a location is to determine the costs of the necessary aggregate of materials and services required, at each location under consideration, to make one unit of the product. An example of selection of the minimum-cost location by this method is given at a later point in this chapter.

Some cost items show a geographic cost pattern clearly shaped by transport costs to or from a few focal points. For example, the prices of iron and steel products are a combination of a base price plus freight from basing point to destination. Fuel prices also show a clearly defined relation to distance from fuel sources; and agricultural products as a rule show price patterns with minima in areas of surplus production and maxima in the major consuming areas.[12]

There are of course many different types of price patterns even in those cases where only a few sources of markets are involved. Their relation to types of competition is dealt with in another chapter; but it may be noted here that some products such as aluminum ingot are sold at a uniform delivered price, regardless of distance from source. To the user of such materials, nearness to the source is of consequence only to the extent that it influences speed or dependability of supply.

Some price patterns are shaped by transport costs, but with reference only to the nearest of many market foci. For instance, the cost of gravel is likely to be made up largely of transportation; yet this commodity is so widely available that the costs of transportation from any one source determine the price in only a very restricted local area. In this case, transport costs shape the local pattern of costs and thus influence the choice of site within the locality for a user of the material; but the interregional pattern of costs and the interregional choice of location are independent of transport costs.

The costs of purchased electric power behave in just the opposite way. Transmission costs increase with added distance from the generating station; but, in general, the rate paid will not reflect this added cost of energy transfer.[13] The customary blanket-rate policies of electric utilities nullify the influence of transport costs within service areas. Within somewhat smaller areas, the same is true of gas and water supply. From the point of view of the individual industrial plant using such utility services, then, the pattern of locational advantage may be shaped by transport costs only in a rough interregional way to the extent that distance

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[11] From Chemical Engineering Flow Sheets published by *Chemical and Metallurgical Engineering* (McGraw-Hill).

[12] See, for example, the maps in *Regional Variations in Prices Received by Farmers*, by A. R. Gans and R. F. Hale, Department of Agriculture, 1939; also figures 84 and 85, p. 211 above.

[13] For fuller discussion and factual material on this point, see Federal Power Commission, *Electric Rate Uniformity* (National Power Survey, Rate Series No. 7, 1936) and W. E. Caine, "Uniform Rate Areas," in *Journal of Land and Public Utility Economics*, May 1932, pp. 148–163. See also figure 74, p. 175 above.

from fuel sources brings about differentials in the levels of gas and electricity charges as between different service areas.

Finally there are nontransportable locational factors, with price patterns entirely independent of transport costs both locally and regionally. Soil, water, and climate are examples; and with the qualifications previously noted, labor costs fall in this category. Local taxes (i. e., the costs of nonmetered public services) likewise belong here.

Sources of Information

The essential information required for location is determined mainly by the requirements of the industry in question, and will generally consist primarily of facts about the supply of materials, labor, power, transportation facilities, and markets but may also include information on the character and cost of sites, taxation, public improvements, housing, and educational and recreational facilities. For particular industries, important information may include climate, topography, population composition and trends, income patterns, and other broader fields.

The information useful in determining a location thus covers a great variety of subjects and is obviously widely scattered among many sources. Sources may be classified for convenience as public or private, and vary in scope from material covering the whole United States to exclusively local data. Since no single body, public or private, has the primary reponsibility of compiling information useful to industrial location, it falls on the manufacturer or his agent to determine what is needed and where to find it.

Impartial information valuable to location studies is provided by many Federal, State, and local government departments and special agencies. For example, the United States Department of Labor compiles and publishes wage and hour statistics and cost of living and price data; the United States Department of Commerce conducts regular censuses of population, manufacturing, distribution, and business and issues special industrial and commercial bulletins; while the Department of the Interior prepares data and maps on topographic features, resources, and so forth. Among special agencies handling information useful to industrial location are the Federal Trade Commission, the Federal Power Commission, the Interstate Commerce Commission, the National Resources Planning Board, the Employment Service of the Federal Security Agency, and the Federal Works Agency.

Regional and State agencies furnish details which supplement information compiled by the Federal Government and cover additional subjects as well. State planning boards, for example, have assembled information on resources and industrial opportunities in their areas and have made special studies of unemployment, skilled and unskilled labor supply, wage scales, cost and location of factory sites, and location of vacant buildings available for industrial occupancy. Taxation and laws affecting industrial operations are among the items covered particularly by local units of government.

Private agencies handling information important to location studies include railroad and power companies, which benefit directly from the location of industries on their lines and maintain departments to aid industries seeking location for new plants or expansion of existing facilities. The railroads are specially qualified to answer questions about freight rates, shipping schedules, and sites adjacent to railroad lines, as the power companies are specially qualified to answer questions about power rates and conditions under which the use of purchased power is economical. Both the railroads and the power companies, through their close contacts with industry, have a valuable fund of information which extends beyond the range of their immediate activities and are in a position to give useful advice about plant location, although their advice may not be impartial with respect to places served by competing companies.

Other private sources of information include trade associations and trade union organizations, and other special interest groups, research organizations such as the National Industrial Conference Board and Standard and Poor's, and civic organizations such as the New England Council and local chambers of commerce. Many of these private sources publish valuable information, and many will answer questions on particular industry problems.

Comparative Evaluation of Locations

On the basis of the fairly definitely known requirements for a specific type of plant and such information as can be assembled on costs of meeting these requirements at different locations, it may often be feasible to compare costs in order to select the best site. An illustration of the comparative analysis of costs of a Portland cement plant at four possible locations is given by Holmes.[14]

> The table * * * shows the computation of delivered-to-customers cost for four possible locations of a cement mill to manufacture for a certain metropolitan market, in which it was believed the mill's annual output of 1,000,000 barrels of cement could be sold. Site A was 5 miles from a property where both limestone and shale could be secured by a royalty arrangement. The limestone was overlain with a suitable shale, the shale, in turn, having an earth overburden of from 6 to 8 feet. Both the limestone and the clay could be transported to the mill

[14] W. Gerald Holmes, *Plant Locotion*, McGraw-Hill, 1930, pp. 6–9.

by a private railway which would have to be built. Site B was 7 miles from good deposits of stone and shale, but both were heavily overburdened and would have to be taken out by separate operations. Trucking was adjudged the most economical means of transportation under the conditions. In this case, also, the raw materials could be taken out on royalty without purchasing property. At C limestone was adjacent to the site, in a hillside quarry, but was very hard. Shale, also, could be taken out at the site. Good limestone deposits were included in the property at site D, and clay could be obtained by a truck haul of a mile and a half.

Location A had a better rate on coal than C, but not as favorable a rate as B and D. Electric power was cheapest at A. C had practically the same power rate as D, but, on account of the hardness of the lime rock available at this point, the engineers estimated that from 15 to 20 percent more energy would be used. Labor was cheapest at C, highest at B, and about average of these at A and D. On account of the hardness of the rock at C, it was estimated that an extra $10,000 a year would be required for repair parts.

From these various unit costs, total delivered-to-customers cost was built up. The results shows that site B, at which raw materials and labor cost most, was the best location. The second best location was A, whose raw materials, coal, and transportation were next to the highest among the four. Site C, the poorest of the four, had cheapest labor, next to lowest raw materials cost, and next to cheapest transportation.

In this particular case, the most advantageous site ranked fourth among the four in raw materials cost, fourth in labor cost, third in power cost, second in taxation, first in coal cost and transportation to the market, and equal to first in works expense exclusive of direct labor. The least advantageous location of the four ranked first in cheapness of labor, second in the cost of raw materials and transportation to market, and fourth in coal, power, and taxes. In the last analysis, the third best location with respect to the total of all items except distribution costs was the most advantageous. The one which ranked best in the total of all items except distribution was third when everything had been included. These apparent inconsistencies make plain the danger of formulating decisions before all the factors have been considered, each in its proper relationship to the others.

Computations of delivered-to-customers cost[1] *location of cement mill*

[Costs are per barrel]

	Site			
	A	B	C	D
Raw materials at the mill:				
Limestone	$0.14	$0.16	$0.13	$0.10
Shale	.02	.03	.02	.03
Gypsum	.04	.04	.04	.04
	[2] (.20)	[2] (.23)	[2] (.19)	[2] (.17)
Fuel and power:				
Coal	.27	.19	.30	.22
Electrical energy	.18	.22	.26	.20
	(.65)	(.64)	(.75)	(.59)
Works expense:				
Mill labor	.14	.16	.12	.14
Superintendence, laboratory, repair parts, etc	.08	.08	.09	.08
	(.87)	(.88)	(.96)	(.81)
General expense and charges:				
Administration and incidentals	.06	.05	.05	.05
Insurance	.01	.01	.01	.01
Taxes (including income)	.06	.08	.10	.08
Bond interest	.05	.05	.05	.05
Amortization	.06	.06	.06	.06
	(1.11)	(1.13)	(1.23)	(1.06)
Distribution:				
Packing, sack cleaning, and sack loss	.07	.07	.07	.07
Sales	.10	.09	.10	.11
Transportation (to market)	.33	.24	.30	.40
Total	1.61	1.53	1.70	1.64

[1] To a large extent these figures are taken from an actual case. Some changes have been made both to increase the effectiveness for purposes of illustration and to conceal the identity of the company.

[2] Figures in parentheses are cumulative totals.

It will be noted that in the above the cost of real estate, plant, and equipment was considered equal in all cases. Some may question this, pointing to the thoroughness of the procedure prescribed, and allege inconsistency. Possibly the charge is sound, but at least in the case used for illustration variations in the cost of plant and property were too small to be taken into account. Such variations as there might eventually prove to be would not affect the senior financing, but, instead, would be provided for by the proprietors of the enterprise.

Since site A was some distance from a sizeable city or town, allowance was made for the maintenance of an administration office in the city where it was expected most of the cement would be sold. But at site A, practically total exemption from taxation was held out as an inducement by the community to secure the mill. Location C was in an adjoining State which had a State income tax. Sales cost was estimated lower at B than at A or C because of its relative proximity to the market, and higher at D because of its greater distance. Transportation charges were computed from prevailing freight rates on cement. The 40-cent rate from site D was disproportionate to the mileage because of an adverse break of rates near the State line which had to be crossed.

Certain limitations of this type of analysis must be noted. Even supposing that accurate estimates of all material and service costs can be obtained, the cold figures fail to tell the whole story. There are always some intangible considerations impossible to translate into pecuniary costs. Questions of convenience and business strategy involve the opinions and preferences of individuals, and the choice between two locations fairly equal in money-cost advantage is often based on such intangible considerations. Instances are on record in which a location selected as ideal from the money-cost viewpoint was rejected because the responsible executive or his family found the proposed location culturally uncongenial.

Another limitation on the comparative cost analysis is the difficulty of projecting relative cost estimates into the future. Locational advantages and disadvantages change with the development of new material sources, shifts in population and markets, and the advent of new transportation facilities and services, new processes, and new products. The correct solution of a plant location problem, therefore, requires a knowledge of trends as well as of the materials and processes.

A case in point is the effect of recent wage and hour legislation on the labor factor in plant location. Prior to that legislation, low wages and long hours

were considered industrial advantages in highly competitive industries. The labor differential, for example, was a major factor in the movement of cotton mills from New England to southern rural districts, where unskilled workers in turn found the wages and hours in the mills preferable to what they had on the farm or in other rural occupations. There may still be a differential after the establishment of minimum wages and maximum hours in conformity with the act, but it is much smaller and may be no longer a major factor in the location of cotton mills.

A somewhat different procedure of comparative evaluation of locations is that of weighted scores, well illustrated by the case of the monel-metal refinery and rolling mill set forth at a later point in this chapter. The essential feature is that the various locational factors are assigned weights proportionate to their assumed relative importance. Thus in the monel-metal case, labor supply was weighted 250, fuel supply 330, and power 100, with other factors bringing the total weight to 1,000. The appraisal of locations involves scoring each location with regard to each factor. The weighted average for each location constitutes the score, the place scoring highest being presumably preferred.

This method permits intangibles to be evaluated and yet gives a definite numerical answer. It should be recognized, however, that it shares all the limitations of the cost-comparison procedure (illustrated above in connection with the cement plant location) and has at least one additional draw-back.

The assignment of weights and scores is of course based on the informed judgment of the investigator, and the result will be as trustworthy as his judgment but no more so. For example, if two locations have approximately equal wage rates but there is the prospect of a more rapid labor turn-over at one of the locations, the scoring procedure would call for grading that location down a certain number of points to take account of the probable loss in efficiency resulting from the higher turn-over. On the other hand, an investigator using the cost-comparison method, as applied to the cement mill, would have to estimate the probable effect of the higher turn-over in terms of labor costs, spoilage of materials, and perhaps various overhead items. In the hands of any given investigator, both methods ought of course to give precisely the same result. The only difference is that in one procedure the estimates are made in dollars and cents and in the other case they are made in points. One is guesswork to the same extent as the other. This being the case, the dollars-and-cents comparison would probably appeal to most people as involving less hocus-pocus and as attempting at least to express the differences in locational advantage in terms of those costs which will actually be affected. Either method is equally well adapted for taking account of imponderables or uncertainties by expert guesswork.

The more important disadvantage of the weighted-score method is that its weights imply that the proportions in which the various materials and services are required are uniform as between different locations. If for instance we give labor costs a weight of 200 and various overhead items 150, we are ignoring the possibility that at a high-labor-cost location it might be feasible to use a somewhat more mechanized method of production and cut down on labor requirements at the expense of some additional machine overhead and power costs. The procedure of cost comparison on the other hand does not suffer from this inflexibility. We can compare the estimated costs of production, delivery, etc., for various locations on the assumption that at each location the set-up most appropriate to local conditions would be used.

Short-Cuts in Finding a Location

It is not difficult to understand why relatively few firms find it possible to make exhaustive surveys for new locations. Certain practical short cuts, however, substantially decrease the time and money involved in such surveys.

One easy procedure is to invite proposals from local chambers of commerce, railroads, power companies, and real estate agents and to base the decision on a comparison of these proposals. This has the disadvantage of not being thorough and of leading to confusion, misunderstanding, and unfair comparisons. It is at least conceivable that biased or incomplete information may be worse than none at all for the comparison of locations, and the difficulty of checking the reliability and comparability of data from different sources is often formidable. Nevertheless this procedure appeals to some executives as easy, inexpensive, and adequate for their purposes. Small manufacturers of consumer goods in particular have been known to use the inquiry about a proposed new location as a means of getting free advertising and offers of financial assistance. The abuse of this procedure has been discussed in another chapter.

Selection of a site may involve several stages of progressive elimination. First there is the choice of a region (for larger firms at least), on the basis of relevant interregional differences of locational advantage. When the region has been chosen, attention may next be directed to a particular size or class of community. Thus a firm making fairly staple grades of clothing or shoes is likely to prefer a town of, say,

5,000 to 15,000 population for the sake of low-cost labor, while a larger-scale establishment such as an aircraft assembly plant must be placed within commuting distance of a much larger population, and certain specialty industries are virtually confined to metropolitan centers. When the region and size and type of community have been determined, the choice is still further narrowed by other stipulations until finally the locations under consideration are few enough to justify intensive individual study. It may happen that several towns offer about the same facilities for most requirements, so that the deciding factors are considerations which otherwise would be secondary, such as the cost and character of sites, taxes, public improvements, housing accommodations, schools, churches, and recreational facilities.

As an example, the International Nickel Co., in searching for a site for a new monel-metal refinery and rolling mill, made a preliminary survey which narrowed the choice to five cities: Bayonne, Buffalo, Baltimore, Pittsburgh, and Huntington (W. Va.). These five were then intensively studied. The final choice of Huntington was based on an analysis described in the appendix to this chapter.

In another actual case, a periodical with a large national circulation conducted a study of the most desirable location for a new publishing plant. The choice of site was limited to points on the Great Lakes and the main line of the New York Central Railroad between New York and Chicago. This was for the convenience of executives traveling between New York and Chicago and to take advantage of water transportation of paper from Canada. Several places were eliminated by unfavorable legislation, high cost of labor, or unsettled labor conditions. The cost and quality of labor and the cost of distribution proved to be the deciding factors.

A more comprehensive system of preliminary weeding-out of locations is the so-called "sieve" method, still virtually untried in this country. Since its effective use would generally involve trade associations or public agencies rather than individual firms, it is described at a later point in this chapter.

Locational Pattern and Public Policy

The foregoing discussion of principles and methods of locational selection has proceeded mainly from the standpoint of the private business enterprise involved. It is properly assumed, from that standpoint, that the objective is a location entailing the best chances for profit.

Public agencies, however, are responsible for taking a broader view. Their interest is not merely that businesses should produce at minimum cost to themselves, but that the locational pattern should contribute to a full and regular use of the fixed resources and labor supplies of regions and communities. To take any intelligent stand on matters involving location, these agencies must understand the factors that have shaped the patterns of individual industries and the probable trends of change in those factors. They must know what local conditions are required for the successful development of a particular type of industry, and conversely, what types of industry may be suited to the potentialities of a specific area.

The execution of a public policy with regard to location can take any of three forms: (a) The actual determination of locations for Government-owned or Government-financed plants; (b) the influencing of private locational decisions through control of transport rates, labor costs, power cost, and other factors; and (c) the provision of data to aid private businesses in choosing profitable locations.

The first two of these lines of action imply positive public policy which could be defined only after additional study. It is to be noted here merely that an additional criterion of importance of locational factors is involved. For policy programs the significance of different factors of location depends upon the extent to which various locational factors lend themselves to the implementation of policy. Even if a particular cost item bulks very large and has a large effect upon locations, it may not be effectively controllable, and therefore may be ineligible for any part in policies designed to shape the locational pattern.

Climate is a good example. It is a locational factor of great importance, even crucial importance for agriculture and recreational activities; yet we cannot control it, and therefore any locational policy must work through other and perhaps less powerful factors. On the other hand, certain items such as taxes may be controlled directly by governmental units; and still others such as water supply, power costs, and supply of skilled labor can be affected to some extent, even if only indirectly. Thus, the relative importance of cost items for purposes of public locational policy is determined by the magnitude of the items as modified by their susceptibility to control.

The aspect of public locational policy which does merit more extended discussion here is the third of those mentioned above: namely, the provision of data to aid private businesses in choosing profitable locations. It is obviously beyond the means of most individual businesses to make comprehensive surveys before selecting locations, and since a great deal of the information required by one firm would also be helpful to many others, public agencies can render private business a valuable service by making such information available.

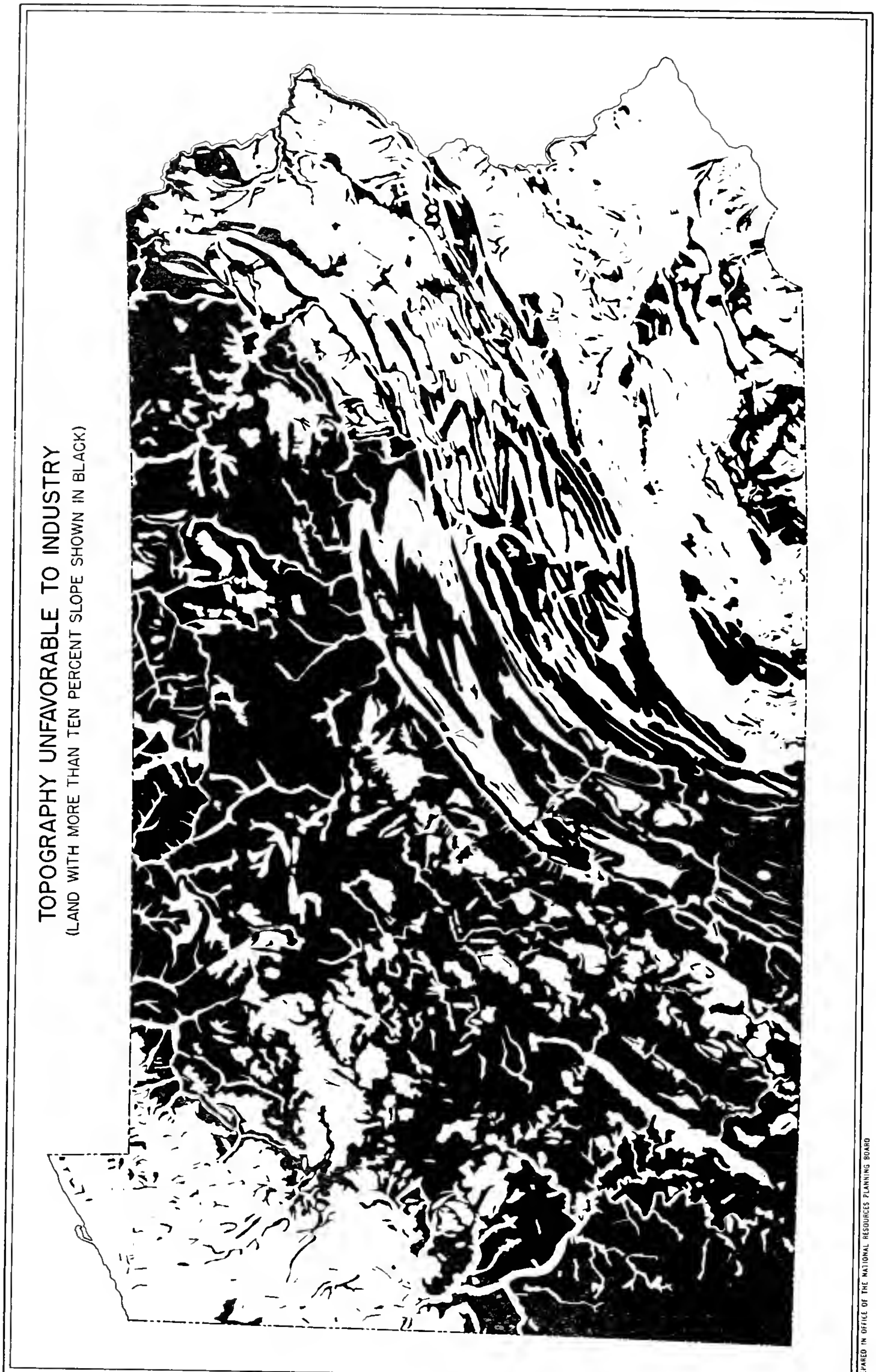

TOPOGRAPHY UNFAVORABLE TO INDUSTRY
(LAND WITH MORE THAN TEN PERCENT SLOPE SHOWN IN BLACK)
PREPARED IN OFFICE OF THE NATIONAL RESOURCES PLANNING BOARD

FIGURE 96

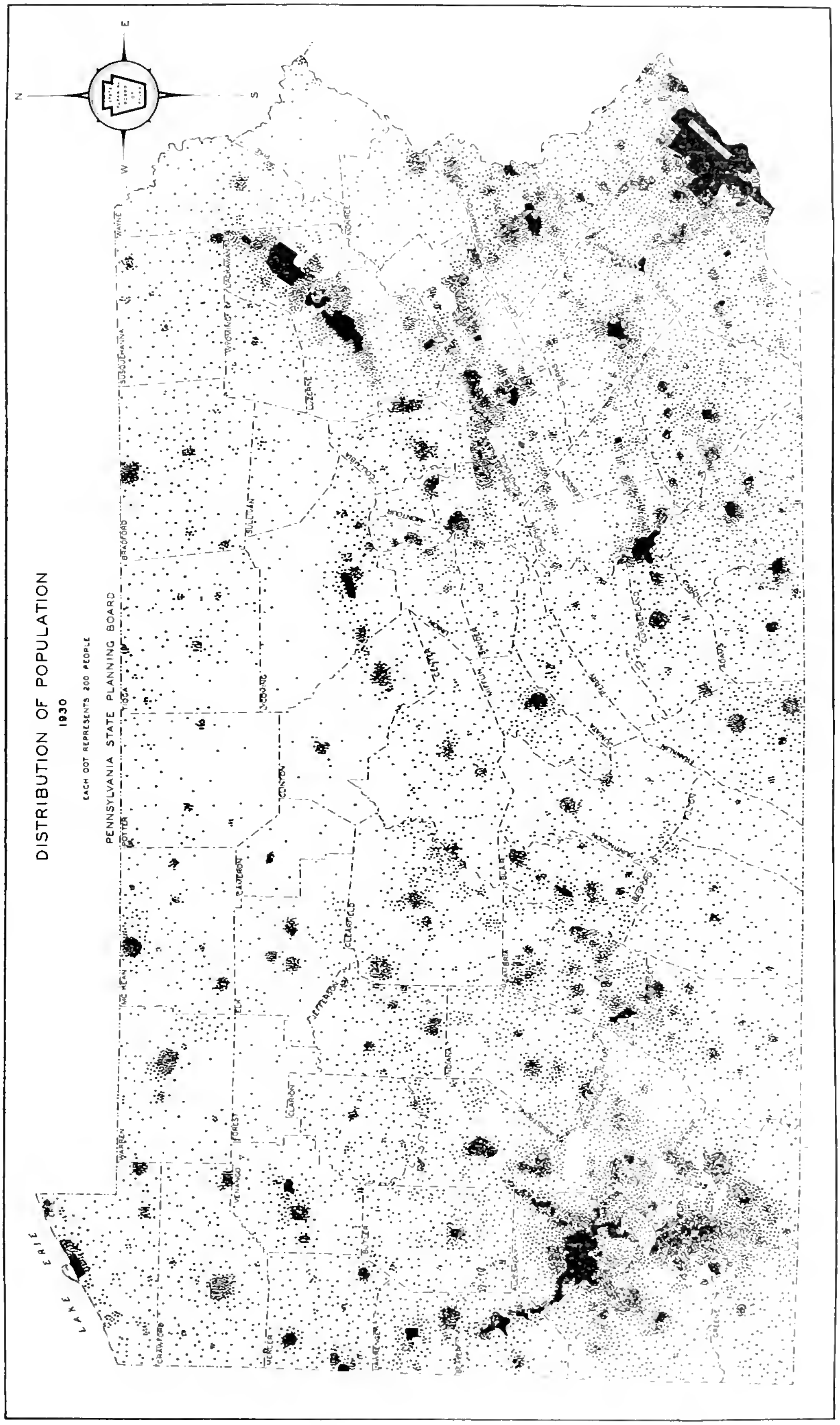

DISTRIBUTION OF POPULATION
1930
EACH DOT REPRESENTS 200 PEOPLE
PENNSYLVANIA STATE PLANNING BOARD
LAKE ERIE
N
S
E
W

FIGURE 97

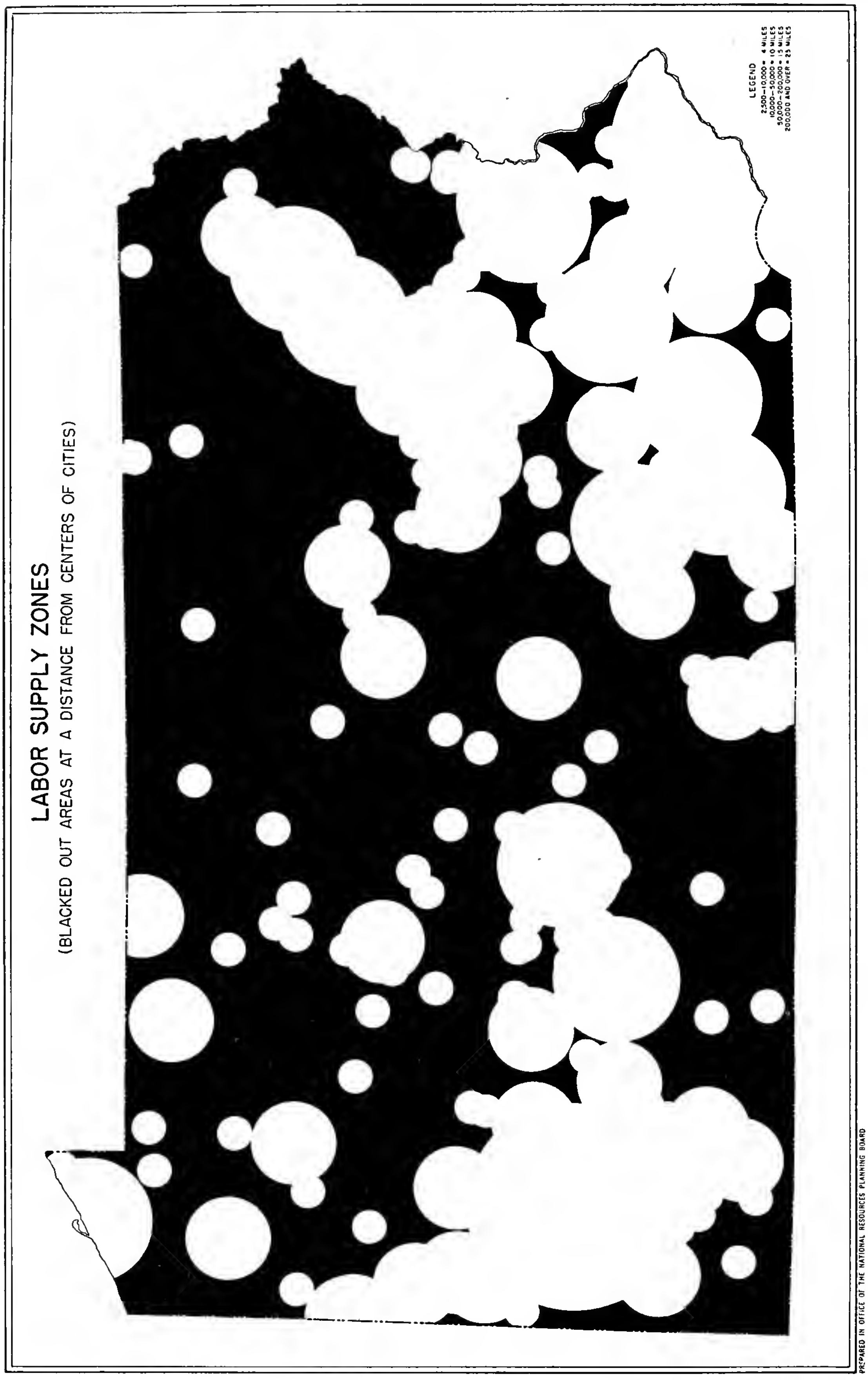

LABOR SUPPLY ZONES
(BLACKED OUT AREAS AT A DISTANCE FROM CENTERS OF CITIES)
LEGEND
2,500–10,000 = 4 MILES
10,000–50,000 = 10 MILES
50,000–200,000 = 15 MILES
200,000 AND OVER = 25 MILES
PREPARED IN OFFICE OF THE NATIONAL RESOURCES PLANNING BOARD

FIGURE 98

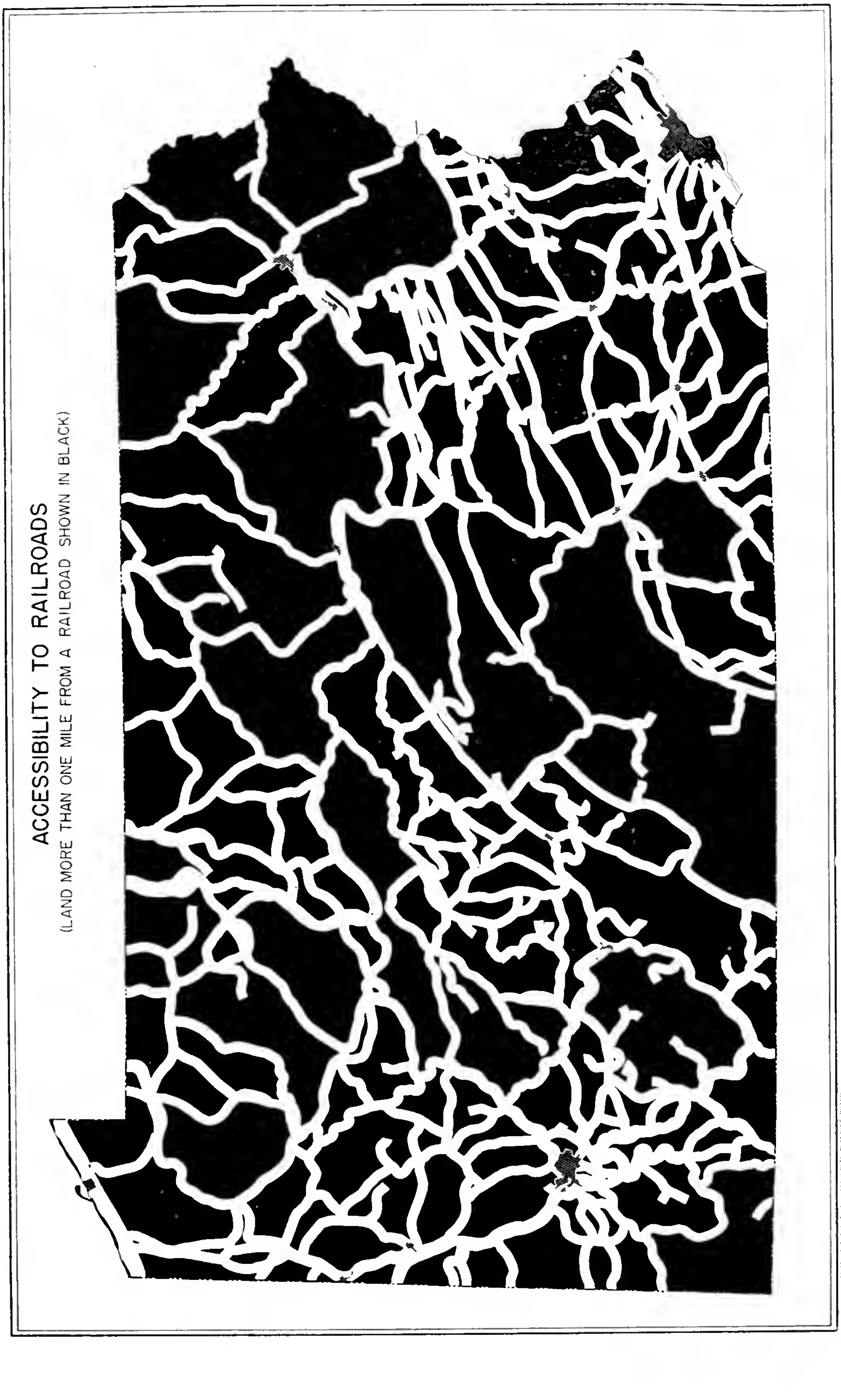
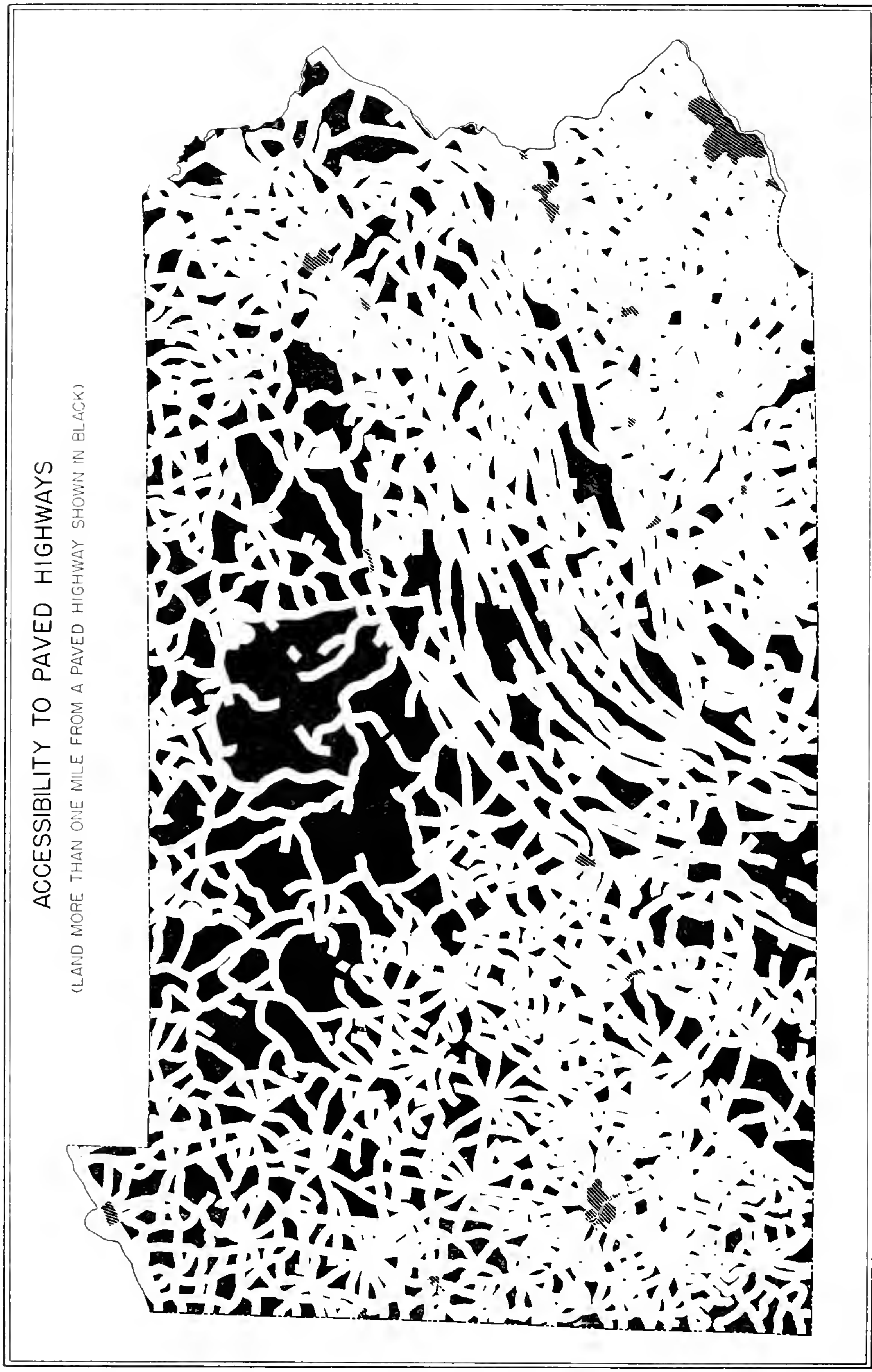

ACCESSIBILITY TO RAILROADS
(LAND MORE THAN ONE MILE FROM A RAILROAD SHOWN IN BLACK)

FIGURE 99



PREPARED IN OFFICE OF THE NATIONAL RESOURCES PLANNING BOARD

FIGURE 100

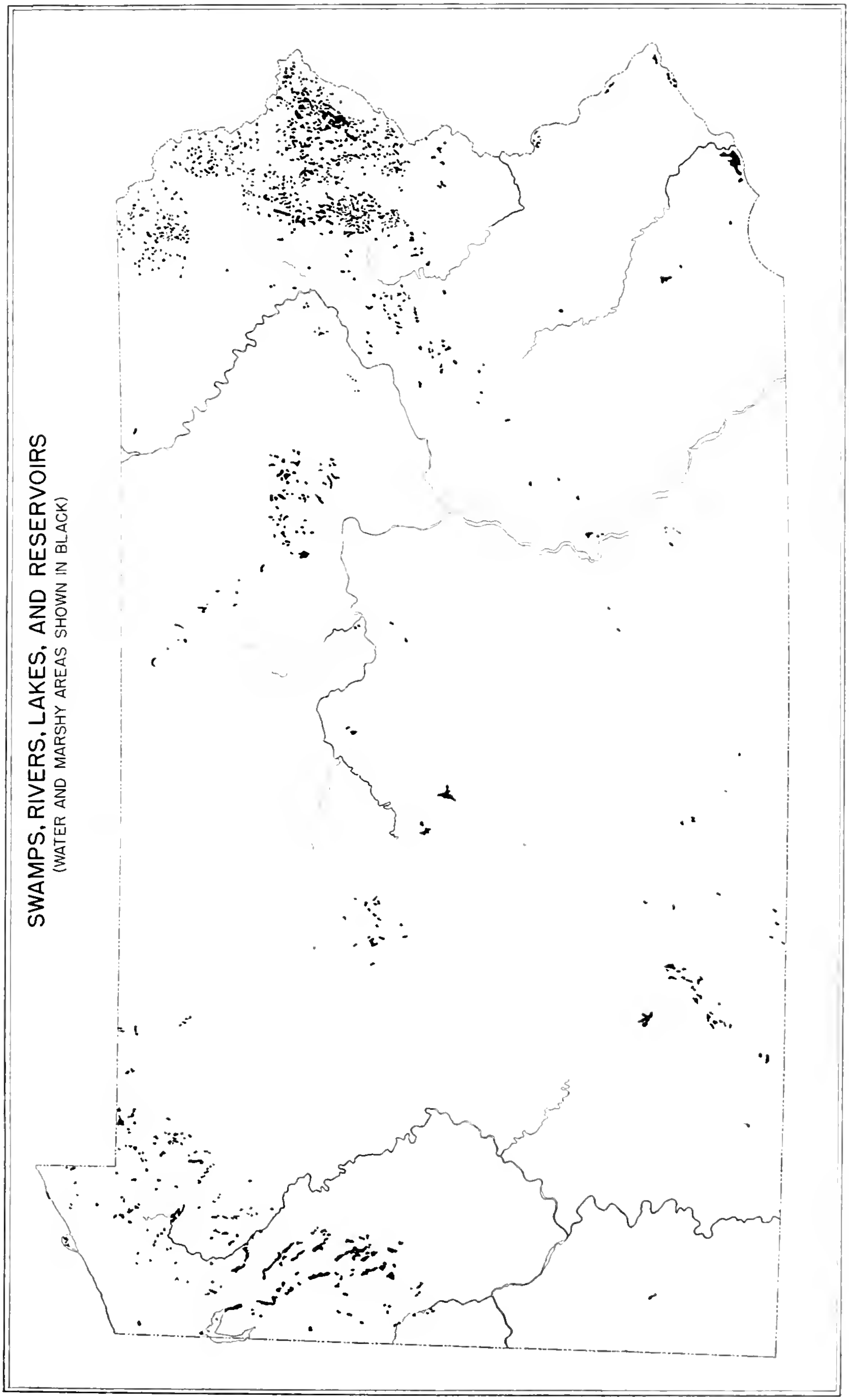

SWAMPS, RIVERS, LAKES, AND RESERVOIRS
(WATER AND MARSHY AREAS SHOWN IN BLACK)

FIGURE 101

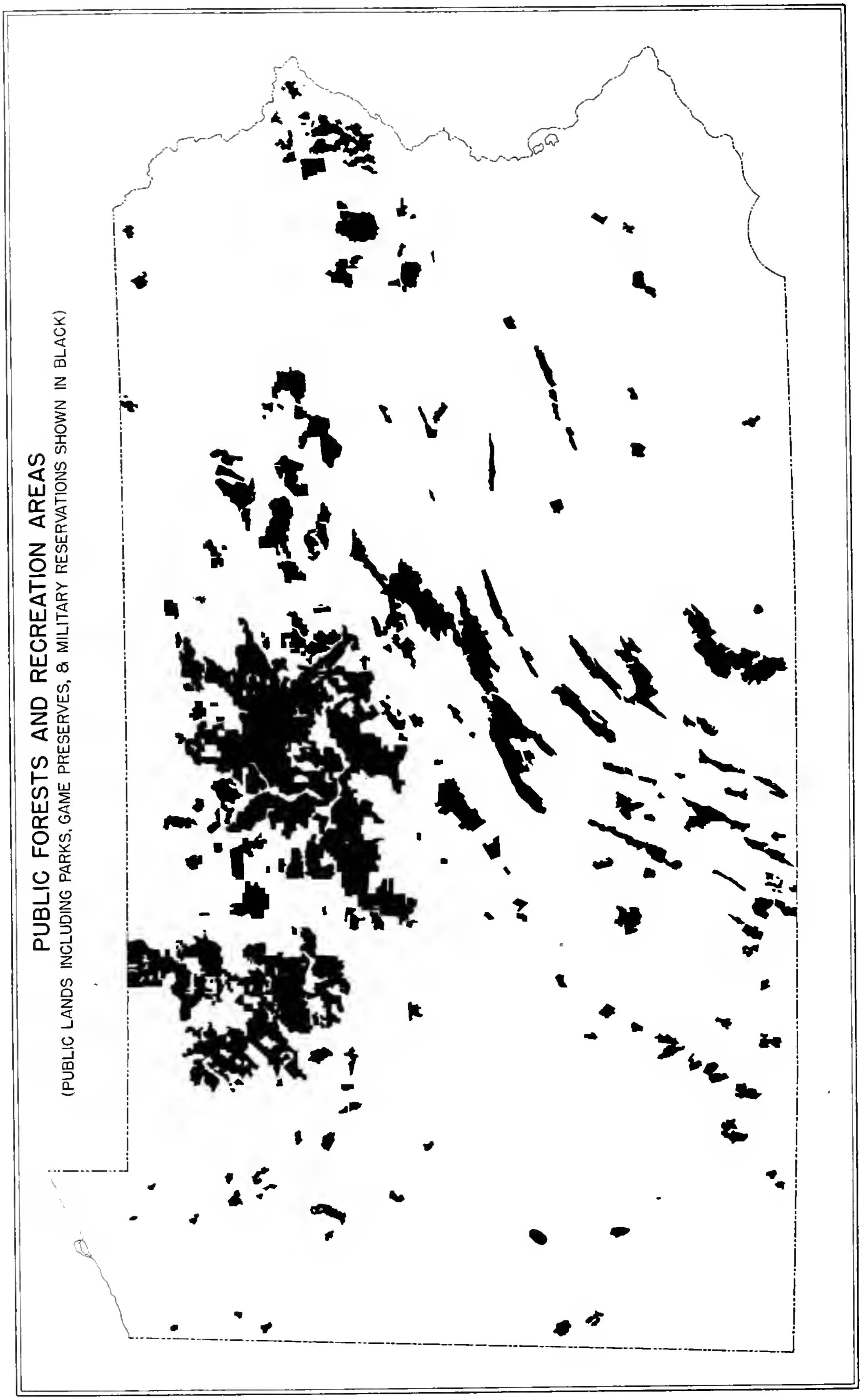
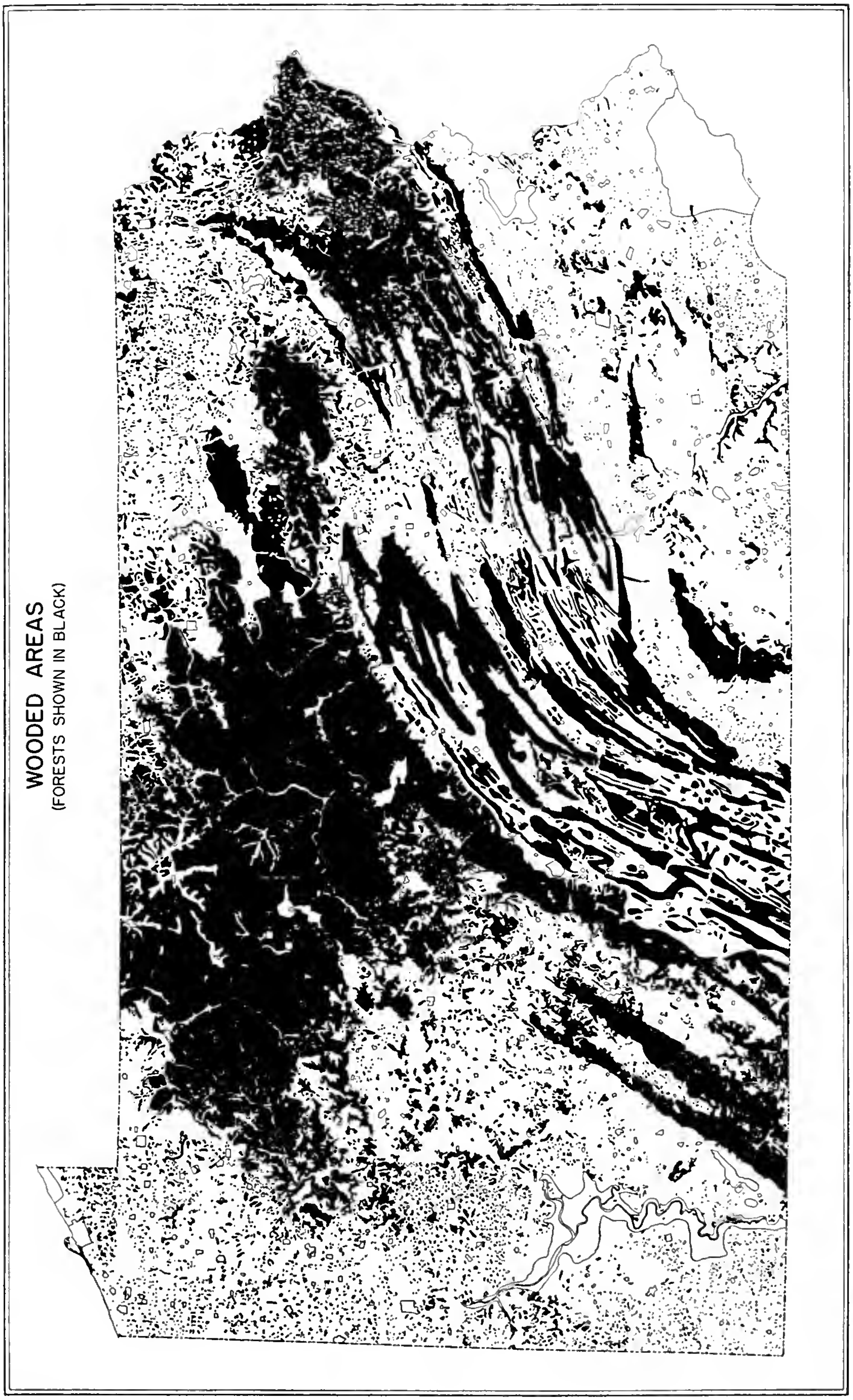

PUBLIC FORESTS AND RECREATION AREAS
(PUBLIC LANDS INCLUDING PARKS, GAME PRESERVES, & MILITARY RESERVATIONS SHOWN IN BLACK)

FIGURE 102



NOTE.—Metropolitan areas of 2,500 or more population are outlined.

FIGURE 103

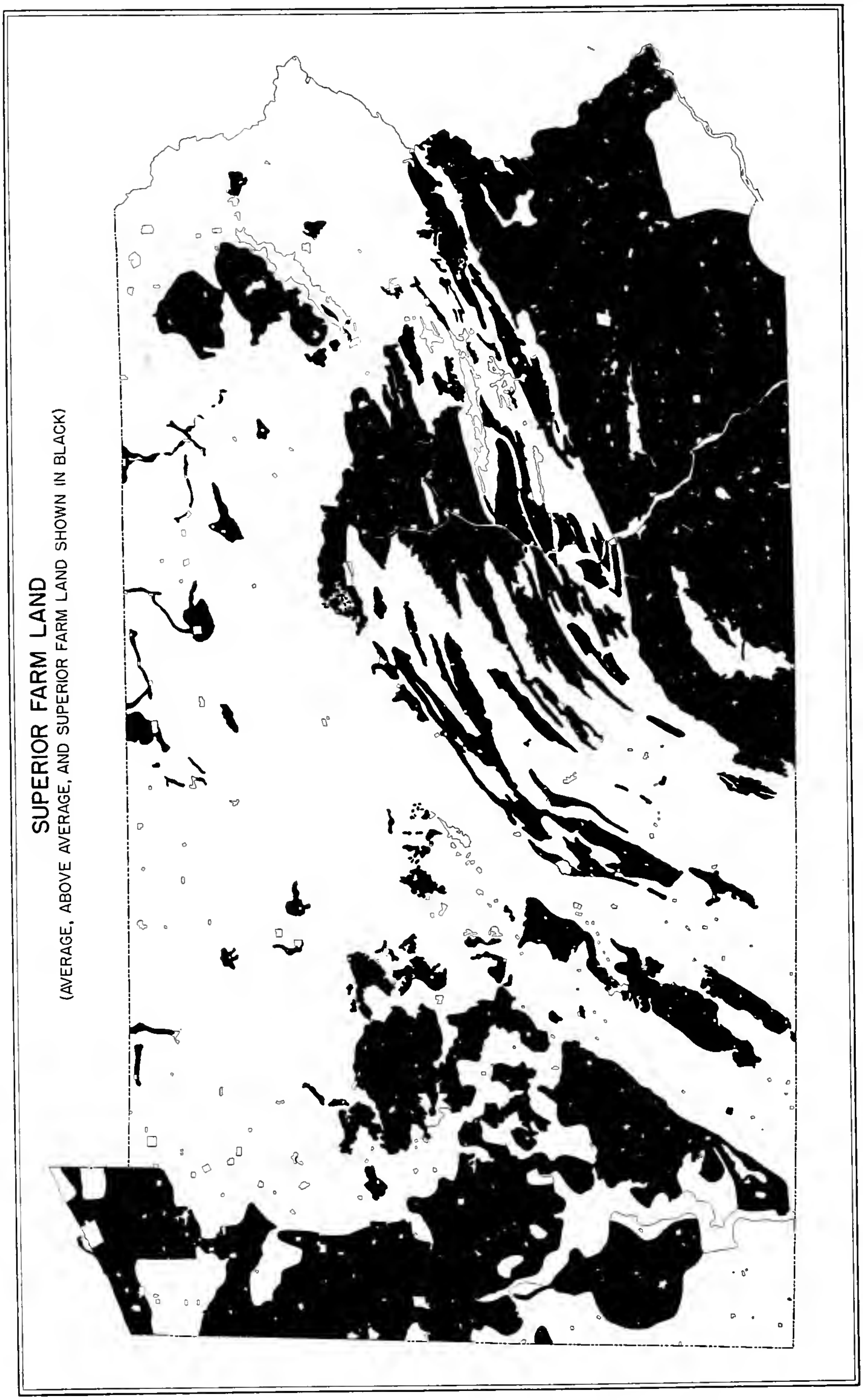


FIGURE 104

NOTE.—Metropolitan areas of 2,500 or more population are outlined.

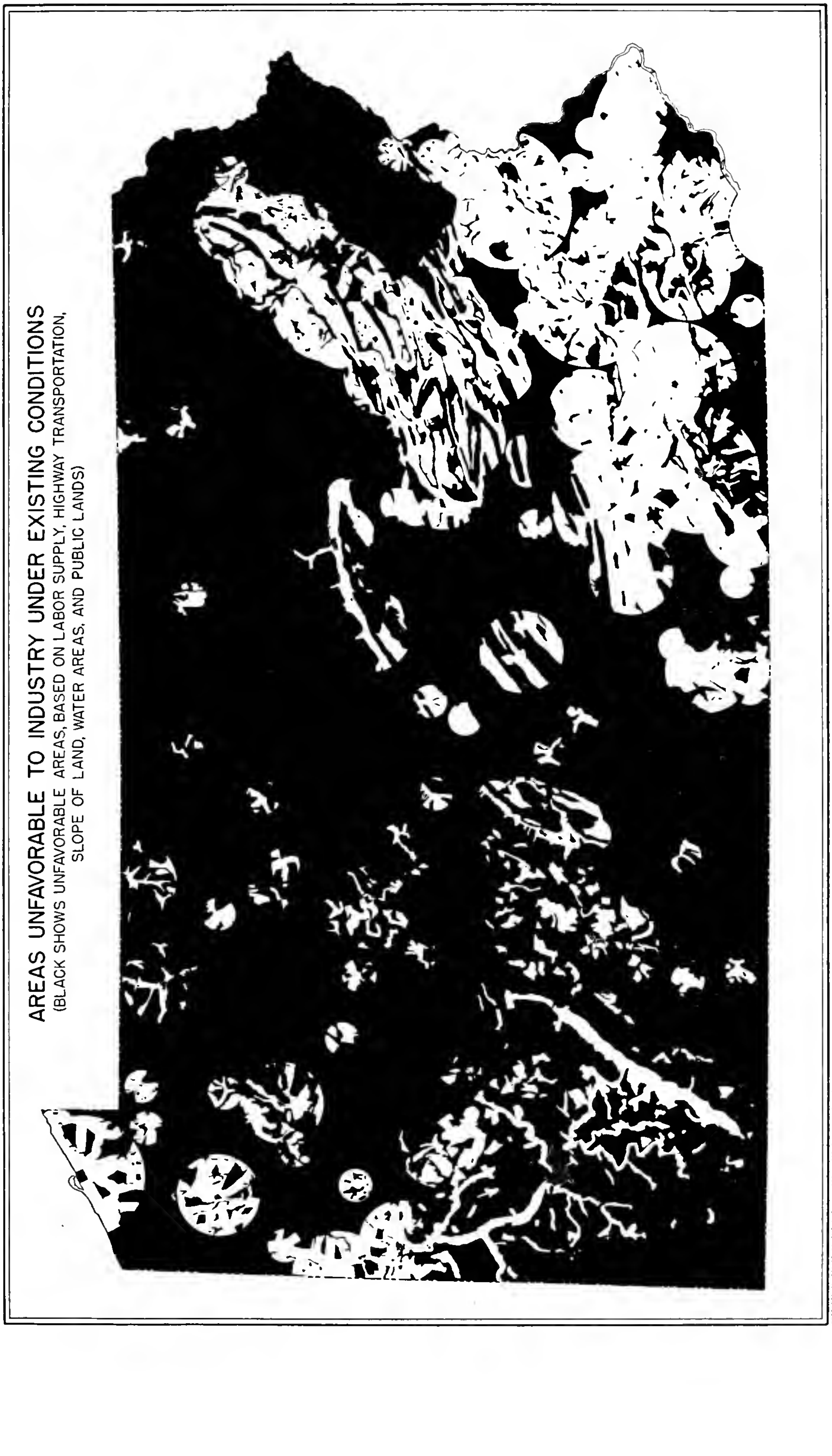

AREAS UNFAVORABLE TO INDUSTRY UNDER EXISTING CONDITIONS
(BLACK SHOWS UNFAVORABLE AREAS, BASED ON LABOR SUPPLY, HIGHWAY TRANSPORTATION,
SLOPE OF LAND, WATER AREAS, AND PUBLIC LANDS)

FIGURE 105

Some indication was given earlier of the range of information now compiled and put at the disposal of business firms for locational and market surveys. Unquestionably a large part of this would never have been collected at all without government participation, because its benefits are diffused over so many users.

The description already given of some representative locational problems of private businesses suggest that still more of the preliminary spade work might be transferred to public agencies with some reduction in duplication of efforts. The case for expansion of this public service in the near future is strengthened by the increased importance of locational shifts involved in war and postwar adjustments, and the augmented Government stake in housing, public services, and production facilities at established locations.

One promising type of basic research for public agencies is the so-called "sieve" procedure, developed a few years ago in Great Britain but still almost unknown in this country.[15] This is essentially a graphical survey of an area for the purpose of narrowing the choice of industrial plant sites by successive exclusion of various unsuitable categories of land. Though most of the actual work is appropriately done at public expense, the results should prove useful not only to planning agencies but also to individual manufacturers seeking sites.

For example, locations generally unsuitable because of topography may be eliminated or "sifted out" of the map. From the remaining areas, one may next eliminate those with inadequate access to transport routes. Various other requirements can be imposed, with the eligible area further restricted at each sifting, until there emerges finally a map of the residual areas which have passed through all the sieves, or in other words have met all the requirements set up.

Such a survey is in effect a rough method of preliminary zoning for industrial development; it does not remove the need for intensive studies of the resources in specific areas and the needs of specific industries or plants, but provides a background from which to approach individual and public problems. By narrowing consideration to a small fraction of the total area it should reduce the number of intensive surveys needed.

The sieve method is illustrated briefly here, with the State of Pennsylvania as an example. A series of maps has been prepared on the same scale, showing: Areas unavailable for industrial purposes because of topography; population and urban centers; transportation facilities (railroads and paved highways); swamp lands; national and State parks, forests, and recreation areas; other forests; and areas of highly productive agricultural land. (See figs. 96–105.)

Figure 96 blacks out those areas of the State of Pennsylvania which are too steep, broken, or inaccessible to be suitable for general industrial development. Topographic sheets of the United States Geological Survey were used to identify areas of less than 10 percent slope,[16] roughly 1 square mile or more in extent, not less than one-fourth mile wide when they occur along river beds and not less than one-half mile wide at all other points. These standards are, of course, arbitrary, and can be readily adjusted for different purposes. It should be noted that not every potential site for a manufacturing establishment is shown in figure 96, which has perforce been generalized; but rather, fairly broad areas which are generally favorable or unfavorable to industry on the basis of topography have been identified. Figure 97 shows the density of population for 1930 [17] on the scale of one dot for every 200 persons. It appears that large sections of the State are at present very sparsely populated and would probably be unable to support industrial activity on any considerable scale because of seriously limited potential labor supply. Figure 98 blacks out areas more than 4 miles distant from the centers of cities of from 2,500 to 10,000 in size, more than 10 miles from the centers of cities of 10,000 to 50,000, more than 15 miles from the centers of cities of 50,000 to 200,000, and more than 25 miles from the centers of cities of greater than 200,000 in population in 1940. These standards were adopted to identify areas of relatively concentrated population with some access to trade facilities and other urban services, and to make an allowance for labor to commute to plants located outside population centers, with wider commutation radii in the case of greater concentrations of population. The specific radii used were chosen on the basis of a study of figures 97 and 98, which helps to account for the close correspondence between areas of sparse population density, as revealed by the dot map, and areas falling outside the circles described. In view of this correspondence it seems legitimate to use figure 98 alone as a rough indicator of magnitude of local labor supplies.

Figure 99 blacks out areas more than 1 mile from existing railroads, again a somewhat arbitrary criterion and more valid for heavy industry than for certain types of light industries as a locational factor; figure 100 similarly blacks out areas more than 1 mile from

[15] See E. G. R. Taylor, "Discussion on the Geographical Distribution of Industry," *Geographical Journal*, vol. XCII, No. 1, July 1938, pp. 22–39.

[16] A movable standard scale was prepared indicating the spacing of contour lines corresponding to a 10-percent slope. In the case of most of the contour maps used, 26 contour lines per inch approximate a 10-percent slope, since each line shows a 20-foot change in elevation and the scale is 1 inch to a mile.

[17] Reference to 1940 population data showed no fundamental change in the distribution pattern as a whole.

paved highways which would probably be a more appropriate standard for such light industries. In figure 101, swamps, rivers, lakes, and reservoirs are blacked out. While these are not permanently unavailable, they are classified as currently unsuitable for industrial use.

The next map of the series (figure 102) blacks out all national and State parks, forest and recreation areas, since these are reserved under existing legislation for other than industrial uses. In figure 103 are indicated other forests in the State of Pennsylvania. Figure 104 shows farm lands of "superior," "above-average," and "average" quality, including forests falling within these categories, as distinguished from below-average and submarginal farm land,[18] other forests, and urban areas. Principal urban areas are shown in outline. Figures 103 and 104 present supplementary categories which might be sieved out as unsuitable for industrial use under certain planning programs, for example forest conservation programs or plans to increase agricultural production. Under the latter type of program it might be assumed that above-average farm lands would have greater value for agricultural than industrial purposes, or at least that a choice between alternative industrial sites should be governed by the quality of land which might thus be removed from agricultural production.

Figure 105, the last of the series, illustrates the application of the sieve method and completes this preliminary survey of the State. Figures 96, 98, 100, 101, and 102 have been superimposed and all blacked-out areas marked on the same outline map,[19] thus eliminating areas unsuitable for industrial location because of excessive slope, small local labor supply (as indicated by distance from an urban center), acute drainage problems, or reservation of land for nonindustrial uses. It does not follow, of course, that all of the residual white area is necessarily suitable for location of industry; it is rather that the blacked-out area is not suitable under existing circumstances and the field of further investigation for industrial location is thus narrowed. Various other combinations of factors might be included in the composite sieve for specific purposes. For example, if one were primarily concerned with heavy industries, figure 99 showing 1-mile distance from railroads would be substituted for figure 100 showing access to highways, and the field would be narrowed considerably more. Again, as was suggested above, a forest conservation program might use figures 102 and 103 in the sieve, thus eliminating from the field of possible industrial sites all present forest lands.

As was indicated at the outset, this exposition of the sieve method is merely suggestive of the utility of a technique which may prove helpful for planning programs, and may also serve the individual manufacturer as a starting point in his search for a site. The latter may in some cases carry the sieve process further by adding conditions of his own (for instance, quality or quantity of water supply, or labor supply), or he may find it best to proceed immediately to the detailed cost comparison at individual sites.

[18] The Pennsylvania State Planning Board definition of "problem areas" shows a high coincidence between areas requiring some adjustment in land use because of seriously depressed economic and social conditions and areas identified here as below average or submarginal agricultural land. See Pennsylvania State Planning Board, *Problem Areas in Pennsylvania*, Publication No. 8, Harrisburg, 1937.

[19] The necessity for transferring all the information to a single outline map is eliminated when transparent sheets are used for all maps and those to be considered are superimposed.

APPENDIX: CASE STUDIES IN PLANT LOCATION

Three actual investigations of plant sites are here described in some detail to illustrate procedures followed by larger firms.

1. International Nickel Co.

The following example is an excerpt from an address delivered before the American Society of Mechanical Engineers in New York City:[1]

The International Nickel Co., in order to provide facilities for the increased requirements of monel metal, has recently completed a refinery and rolling mill at Huntington, W. Va.

The location of a new works requires the study of engineers with both technical and practical experience and imagination. Capital expenditure, operating costs, and future possibilities, have each to be weighed carefully.

With the survey of requirements and the conclusions available, the following districts were given particular study: Bayonne, N. J.; Buffalo, N. Y.; Baltimore, Maryland; Pittsburgh, Pa.; and Huntington, W. Va.

The territory and the principal railroads which serve customers and prospective markets for refinery and mill products provide good facilities for export shipment. This territory covers the intensive manufacturing districts of the United States, with Chicago and St. Louis in the West, and New York and Philadelphia in the East, and it will be noted that Huntington, W. Va., occupies a geographic position central to the territory, and is also in close proximity to external natural resources, among which coal and natural gas are the most important.

Bayonne, N. J., was considered, as the International Nickel Co.'s largest refinery had been established there many years, and it was thought the rolling mill might be an addition to the existing works. The investigation resulted, however, in the Bayonne refinery being discontinued, the plant dismantled, and one of the most valuable sites on New York Harbor made available for some other industry for which the economic conditions are excellent, but which are unfavorable for the refinery and rolling mill. Important changes and extensions have therefore been made at the Port Colborne refinery so that nickel

[1] *Proceedings of American Society of Mechanical Engineers.*

in all forms can be refined in Canada, and the refinery with rolling mill has been constructed at Huntington, W. Va., for the production of monel metal, malleable nickel, and other specialties.

The following is a schedule of economic factors investigated:

Labor	Skilled. Common.		Type. Supply. Rates. Strikes.
Fuels	Metallurgical power generation.	Cost and Quantity	Oil. Producer gas. Natural gas. Coal. Coke.
Power	Public Service Electric Supply		Cost. Service.
Living condition	Housing. Cost of living. Sanitation and health.		
Climate	Minimum and maximum average temperatures. Average snowfall. Average rainfall.		
Water supply	Service. Costs. Quality.		
Taxes and laws	State. Local.		
Selection of site	Railroad connections. Character of ground for building and equipment foundations. Drainage and flood conditions. Accessibility for labor. Grading and facilities for slag disposal. Provision for expansion of works.		
Construction costs	Labor. Material. Supplies.		

The following represent the comparative ratings given to the economic factors:

Labor	250	Climate	50
Fuels	330	Supplies	60
Power	100	Taxes and laws	20
Living conditions	100	Site (cost and quality)	10
Transportation	50	Construction cost	20
Water supply	10		

The comparative ratings given, economic factors for the principal locations studies are as follows:

	Locations				
	Huntington	A	B	C	D
Labor	100	90	82	75	65
Fuels	100	55	50	60	55
Power	100	90	95	90	60
Living conditions	100	90	90	85	80
Transportation	100	95	90	85	80
Water	100	90	75	85	15
Climate	100	90	85	90	85
Supplies	100	90	90	95	85
Taxes and laws	100	100	100	90	80
Site (cost and quality)	100	75	50	50	30
Construction cost	100	90	80	80	70

Connections with 13 important railroads are within 175 miles of Huntington, W. Va.

The following general conditions apply to the district of Huntington, W. Va. which are considered especially suitable for the industry described:

Labor.—Labor is made up of 95 percent English-speaking Americans, both common and skilled, with good records in the territory in diversified industries; the turn-over is light and a majority of the workers own their homes.

Fuels.—A plentiful supply of natural gas for manufacturing and domestic purposes, from public utility companies, is available at a cost of from 21 to 22 cents per 1,000 cubic feet (1,100 B. T. U. per cubit foot). Investigation of developed and undeveloped gas fields indicates supply of gas for 15 to 20 years. A good supply of high-grade oil of low sulphur content is available from the local oil refinery at a present price of 5 to 6 cents per gallon delivered at plant. There is an excellent supply of high-grade bituminous steam and gas coals from local coal fields costing $2.50 to $3 00 per ton, delivered at the plant.

Power.—Two modern central stations supply power at a cost to large industries of 11 to 12 mills per kilowatt hour.

Transportation.—Thirteen important railroads make connections within 175 miles. The Ohio River is navigable all the year, traffic between Pittsburgh, Huntington, and Cincinnati being on regular schedule.

Water.—Both river and borehole water of good quality are available, the latter at an average depth of 60 feet.

Climate.—The climate is equable, with generally cool nights and little snowfall.

Supplies.—Refractories, charcoal, castings, and steel are obtainable in the district.

Taxes and Laws.—These compare favorably with those of other districts. There are no smoke laws in West Virginia.

Site.—A site of 76 acres was procured just outside the present city boundary of Huntington and directly connected to the Chesapeake & Ohio Railroad, and will be similarly connected with the Baltimore & Ohio Railroad when extensions now planned are completed. The site is also on the Guyan River and within about a mile of its junction with the Ohio River. The topography of about 10 acres of the 76 is ideal for use as a gravity slag dump. Flood conditions in the Ohio Valley were studied and records for about 40 years were analyzed, which showed that only on two occasions—the last being the 1931 flood—had flood water been sufficiently high to endanger to a small extent property at the elevation of the site selected. The ground for foundations is excellent, being solid clay for a depth of from 12 to 18 feet, underneath which is a stratum of coarse, compact sand. The location was sufficiently close to Huntington, which is a growing city of about 75,000 inhabitants, to obviate the necessity of the company building homes for officials or workmen. Housing conditions are at this time very satisfactory being similar to conditions in other prosperous communities.

2. International Harvester Co.[2]

* * * The International Harvester Co. has expanded its plant facilitates in recent years largely by additions to existing works rather than by the construction of entirely new plants. A new plant to make truck engines was recently completed, however, at Indianapolis, Ind. The following analysis is largely based upon memoranda in the company's files and

[2] Douglas V. Brown, *et al.*, *Industrial Wage Rates, Labor Costs, and Price Policies,* Monograph No. 5, Temporary National Economic Committee, Washington, 1940.

others prepared especially by President McAllister for this inquiry.

Prior to the construction of this new plant the engines for the smaller models of trucks, manufactured at Springfield, Ohio, were made at the Farmall works in Rock Island, Ill. With the expansion in tractor and truck sales in 1935–37, it became difficult to make the required number of truck engines at Farmall plant. In addition, engines were made at the tractor works in Chicago for one size (the F–30) of the tractors manufactured in the Farmall plant. The construction of a new truck-engine plant not only would expand capacity but also would permit the transfer to the new plant of the truck motors made at Farmall and the transfer to the Farmall plant of the F–30 tractor motors from the tractor works in Chicago. It would also make possible the transfer of the manufacture of engines for the larger truck from Fort Wayne to the new plant, thus concentrating all truck-engine manufacture in one plant, and freeing the facilities at Fort Wayne for expanding the manufacture of axles, transmission, and other parts.

The company analyzed four possible locations: Springfield, Ohio, Fort Wayne, Rock Island, and Indianapolis. Since the existing Springfield assembly plant was to use most of the engines produced by the contemplated unit, it would have been desirable to locate the new factory there, but there was no satisfactory site available and, according to President McAllister: "The location of an engine plant at Springfield would have doubled the number of International Harvester Co. employees, bringing the total, in times of full production to 10,000 employees in a town of 65,000 inhabitants. This was regarded as too high a ratio, creating too much of a one-industry town where fluctuations in business are felt more severely than in a larger town with a larger number of industries whose ups and down to some extent offset each other."

Springfield having been eliminated, the remaining locations, Rock Island, Fort Wayne, and Indianapolis, were compared in detail. Attention was focused on the following factors: The character of the site, freight charges, and the nature of the labor force.

In selecting a site, the amount of land required for the plant, with allowance for possible expansion, was compared with existing land-holdings and the availability of adjoining parcels in cities where the company held properties. In other cities the availability of sites was canvassed, and the costs of additional purchases, taxes, public utility services, railroad and transportation facilities were compared. The company has provided land for employees' gardens in connection with a number of its plants and the availability of land which would be used for this purpose was investigated.

In considering transportation costs, freight charges for transporting the motors produced at the proposed plant to Springfield and Fort Wayne from each location under consideration with the new plant operating at various levels of production, were compared.

The labor market in each location was also studied in detail and the number and the quality of the prospective labor force canvassed with reference to their skill and training. In this connection, the United States Employment Service offices in the various cities provided considerable information. The company knew the occupational groupings that would be required in the new plant, and the employment offices provided approximate estimates of the number of unemployed persons available in these occupations. As plants of the International Harvester Co. were already located at two of the three cities seriously considered (Fort Wayne and Rock Island), the works superintendent and other officials at each plant were consulted as to the quantity and quality of available workers. The fact that companies in the automobile industry had previously been located in Indianapolis, where the company did not have a plant, was considered to be an important indication of the availability of a labor force of the general type required.

The relative cost of living in the cities under consideration was also examined. Studies of cost of living in Fort Wayne and Springfield made by the works councils of the International Harvester Co. were utilized, and reports of the Bureau of Labor Statistics indicating trends in the costs of living in comparison with other cities were analyzed where they were available. Housing facilities for added wage earners needed by the plant were also given particular attention.

Comparative studies were made of prevailing wage rates. Plant superintendents furnished information regarding wage rates in various industries in Fort Wayne and Rock Island, while special agents were sent to Indianapolis to secure data on prevailing wage rates. In a memorandum on the Indianapolis decision the company investigators reported that common-labor rates in that city were about 20 percent below those in any other city considered.

The officials of the International Harvester Co. have stated that they did not expect the wage differential between Indianapolis and the other cities considered to be maintained over a long period of years and hence it did not carry great weight in their decision to locate there. A number of firms going out of business in Indianapolis during the depression and the large labor supply had forced wages down to an unusually low level. The return of industry, illustrated by the construction of this plant of the International Harvester Co., could be expected to increase wage rates to a level more nearly comparable with that in other cities.

The character and the degree of unionization in each city was also studied, and the specific occupations and industries in which unions were present were listed.

As in the case of Springfield, the proportion of the total population which would be in the employment of the International Harvester Co. if the proposed plant were constructed, particularly at peak levels of operations, received considerable attention. It was considered undesirable to have a very high proportion of the workers in any one city in the employment of the International Harvester Co., as fluctuations in its production schedules would influence the whole community, and rapidly, during periods of peak operations. On the other hand, if industry in the city were diversified, the peak periods for the various concerns might tend to dovetail, permitting transfer of employees from one to another as each hit its production peak. Competitive demands for labor on the part of other important firms in each prospective city received consideration and special attention was focused on the potential demand for skilled labor.

On the basis of these considerations it was determined to locate the plant at Indianapolis. Mr. McAllister, the President of the International Harvester Co., has indicated that:

The controlling reasons which led the management to decide on Indianapolis as the location for the new engine plant may be summarized as follows:

1. A desirable site was obtainable outside of the city limits and not subject to city taxes but easily accessible by streetcar and with water, sewer, light, and power facilities available.

2. An adequate supply of common labor and of labor already skilled or capable of training. Indianapolis had been unfortunate in the closing down of a number of industries, leaving a

large unemployment problem. The city officials, chamber of commerce, and citizens generally were all anxious to relieve this situation by bringing about the location of new industries and were very cooperative and helpful in locating and obtaining a desirable plant site with railroad and all other necessary facilities.

3. Satisfactory housing situation.
4. Low cost of living.

3. Yankee Metal Products Corporation [8]

This company manufactures a line of products which is nationally distributed and not dependent in any way on local trade. The business was founded in 1915 in New York City. Three moves were made in the 25 years that have elapsed since then; two of these to new locations within New York City. The third move, made during the summer of 1934, took the company 42 miles to Connecticut. It is that last move and all the circumstances surrounding it that form the basis for this discussion.

For a long time prior to the actual move, the conviction had been growing on company officials that a big city was no place for such a concern. After more than 18 years of steady expansion, they began to feel the disadvantage of such location. The idea of relocating did not actually crystallize, however, until early in April of 1933. A very definite necessity forced the issue to a head. This was the extreme urgency of an immediate and drastic reduction in fixed overhead expenses. * * *

The analysis was to be two-fold; Statistical and factual. Some of the information needed was:

1. Rental.
2. Labor availability.
3. Power rates.
4. Local and State taxes, license fees, etc.
5. Compensation insurance rates.
6. Fire and other insurance rates.
7. Transportation facilities and rates.
8. Water supply and sewerage.
9. Fire and police protection.
10. Living conditions.

Now began the search for that ideal location. Prospects were plentiful, but most were eliminated very quickly for one reason or another. Feeling that local chambers of commerce would best be able to supply the information sought, the company officials decided to work through them and the decision was made on the basis of facts supplied in this way.

Long Island, New Jersey, Westchester, and other locations around metropolitan New York were all considered. Southern Connecticut was finally selected because there were most nearly found all the things the company was looking for.

With the needed information available, a comparative statement of income and expense was drawn up showing actual 1933 figures in New York as against estimated 1934 expenses in both the new location and New York. A fairly accurate idea of savings to be effected was obtained by use of this statement, and it proved an important element in the final decision.

The factual statement was prepared by listing all of the factors to be considered, showing alongside of each, side by side, the advantages and disadvantages of the move. Such factors, and the weight to be given each, are peculiar to the individual company. Here are some of the elements of the move this company gave careful consideration:

1. Overhead expenses.
2. Labor availability.
3. Sources of supply.
4. Market.
5. Power.
6. Water supply and sewerage.
7. Transportation.
8. Climate.
9. Living conditions.
10. Profit possibilities; business life.
11. Moving costs and annoyances.
12. Present contract obligations.

With these analyses before us, a study of the relative advantages and disadvantages of the move presented no great problem.

Greatest weight was given to the question of overhead expenses since that concerned this company most. Since only a relatively small proportion of their labor needs are in skilled field, the factor of labor availability concerned them less. As mentioned before, each company has its own problems in that respect. In some instances, proximity to sources of supply may be the all-important factor; in others, the question of markets may be of greatest concern. Proper weighing of the factors is as important, therefore, as in complete knowledge regarding each of them.

Here is the picture as it presented itself to the company officials:

1. An estimated economy of 10 percent in overhead expenses.
2. The prospect of offsetting the total cost of the move within 1 year by savings effected during that time.
3. Suitable labor available.
4. Good power at lower rates.
5. Lower compensation and other insurance rates.
6. No advantages as to sources of supply or market.
7. No prohibitive taxes or regulations.
8. Good and plentiful water as well as good sewerage.

Since all of this was not guesswork, but facts presented in concise and clear form, all opposition to the move soon dissipated, with results that are now history. The considerations affecting relocation are listed below.

Summary of advantages and disadvantages of relocation [1]

Factor	Advantages	Disadvantages
Overhead	Annual saving of approximately $10,000 in rental. Lower compensation rates and power rates.	Possibility of increased transportation charges on outgoing shipments, and possible need of New York showroom facilities.
Power	All forms of power available at lower rates.	
Climate	This is a negligible factor in our business aside from the humidity factor which is probably the same in both places since both are near the sea.	
Living conditions	Excellent. Near New York.	Away from family and friends.
Moving	Chance to replan and relayout the factory to take advantage of things we have learned. Clean out great deal of accumulated junk.	Cost of moving. Loss of production. Loss of customers due to poor deliveries during moving period.
Sources of supply	Closer to main sources. On main line of New York, New Haven & Hartford. Most that can be lost on materials from New York and Midwest is 1 day, which can easily be anticipated. Quite sure we can obtain most New York goods on basis of f.o.b. our factory. Increased freight costs on others not a very large factor.	Farther away from glass sources. Additional delay in obtaining material from New York and Midwest (not over 1 day). Increased transportation cost on some incoming materials.

[8] Based on statement by J. M. Robins, general manager, in *Factory Management and Maintenance*, vol. 98, No. 6, June 1940, p. 60.

[1] Analyses of all factors involved in moving produced this line-up of advantages and disadvantages. The complete analysis afforded the factual basis for a decision, contingent on the statistical study that showed the move would be profitable.

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*For statistics by State or for specific industries, consult subject headings.